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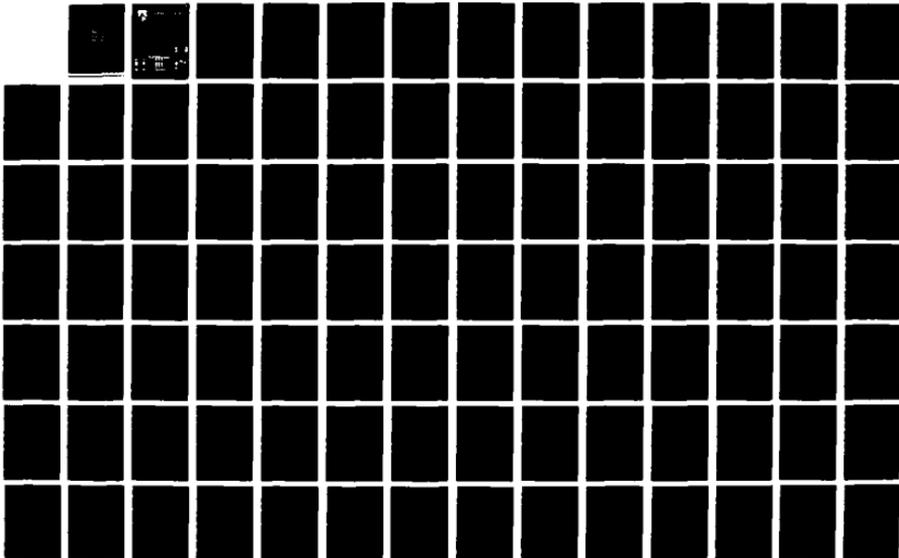
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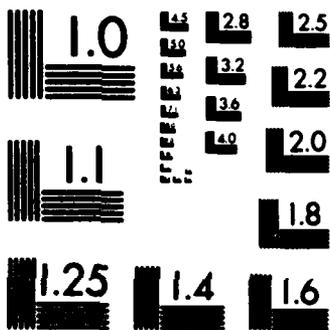
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## RESEARCH REPORT

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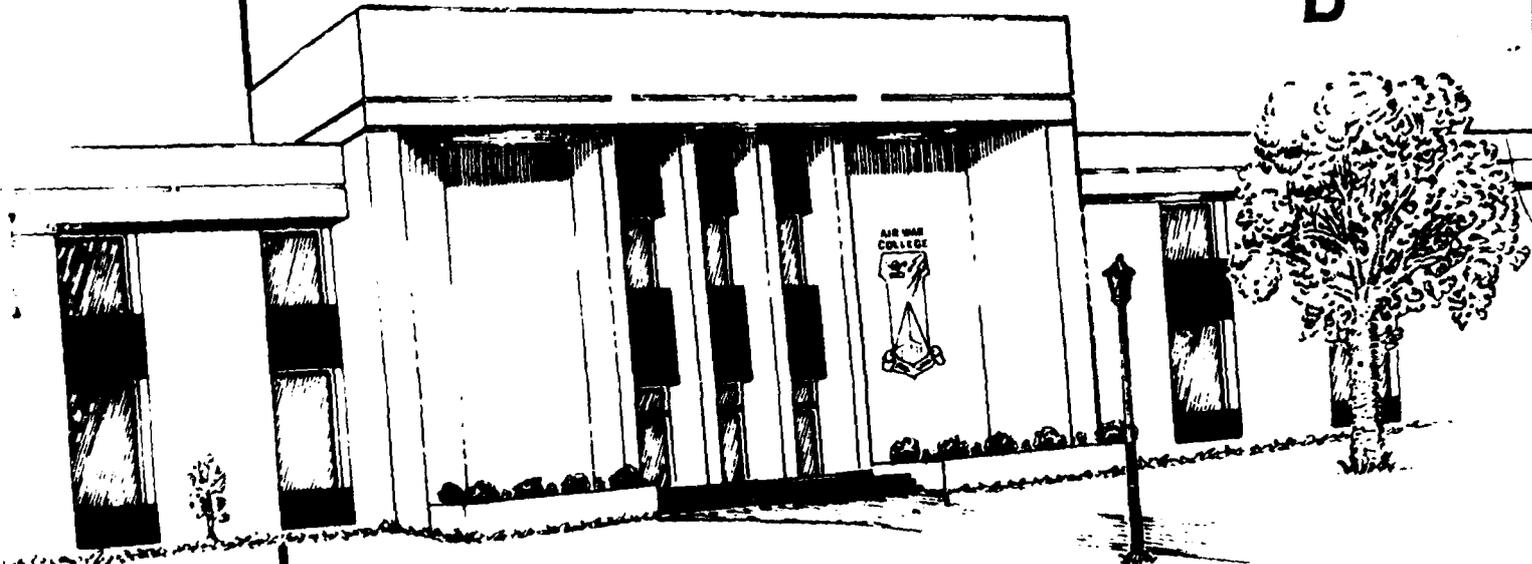
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PLANNING FOR THEATER WARFARE USING THE  
CONCEPT OF MASSIVE AIR STRIKE TO INSURE SUCCESS

By BRIGADIER GENERAL ABDEL HAMID SOROUR,  
EGYPTIAN AIR FORCE

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PLANNING FOR THEATER WARFARE USING THE CONCEPT  
OF MASSIVE AIR STRIKE TO INSURE SUCCESS

by

A. H. Sorour  
Brigadier General, Egypt

A RESEARCH REPORT SUBMITTED TO THE FACULTY  
IN  
FULFILLMENT OF THE RESEARCH  
REQUIREMENT

Thesis Advisor: Dr. Robert L. Wendzel  
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MAXWELL AIR FORCE BASE, ALABAMA

APRIL 1987



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AIR WAR COLLEGE RESEARCH REPORT ABSTRACT

TITLE: Planning for Theater Warfare Using the Concept of  
Massive Air Strike to Insure Success

AUTHOR: A. H. Sorour, Brigadier General, Egypt

✓  
To include  
Historical background about the role of airpower in achieving victory and the development of this role through the military history; The effect of technology on the current classification of air force missions; The author's views on existing interrelations among these missions in the operational theater and his perspective on reclassification of air force missions; <sup>and</sup> A description of air force objectives during the Air Land Battle and the author's suggestions about using the concept of Massive Air Strikes to achieve these objectives. <sup>(in study)</sup> Emphasizes the planning process and the calculations required to estimate the expected relative results and their effect on the theater air force's role in the Air Land Battle. ✈

## BIOGRAPHICAL SKETCH

Brigadier General A. H. Sorour (Egyptian Air Force) has been interested in the planning process throughout his job as a chief of navigators for 15 years in a bomber wing and for five years in an F-4 wing. He served in the Egyptian Air Force (EAF) Headquarters for four years as a deputy chief of the navigation department. He is a graduate of the EAF Staff College, where his research on the proper way to use fighter/bombers in modern war received the first place award in his class. Also, he is a graduate of the High War College (Nasser Academy) in Cairo, where his research on the Massive Air Strike received the only superior rating in his class. In 1986, his research on the planning process in the air force brought him an award from the Ministry of Defense. He participated in four wars in the Middle East as a planner and as a flying crew member. He received three medals for his service. Brigadier General Sorour is a graduate of Cairo University where he received his degree in management. He has had his Master's Degree in aviation since 1978. He is a member of High War College (Nasser Academy) and he received his PhD in 1986.

## 1. INTRODUCTION

### 1.1 The Development of the Role of Airpower:

a. It was in World War I that airplanes began to play a role in combat. However, scientific theories concerning the use of the air forces were lacking due to the defensive nature of that conflict and the newness of the weapon system. Planes were unsophisticated, loaded with small, ineffective bombs and armed only with machine guns.

b. It became clear that the significant development of the war plane's range, armament and cargo was essential for achieving aerial supremacy. Aerial supremacy would be extremely useful in future conflicts and these capabilities were pursued in earnest after the cessation of hostilities.

c. Gradually, the strategic role of the Air Force emerged as the importance of airpower was better understood and appreciated along with the rise in importance of armoured units. Military thinking began to focus on using the different branches of the armed forces in a well-orchestrated strategy. In the 1930's three major wars--the Sino-Japanese, the Ethiopian, and the Spanish Civil War--provided useful laboratories and testing grounds for the new weapons and employment techniques.

d. During these wars, new aerial tactics rose to prominence. Airplanes were used for launching air-surface

missiles, dropping paratroopers, attacking warships, and destroying enemy mobilization centers and supply lines.

e. World War II proved many of the new aerial theories as the Air Force began to play a decisive role in the battle. The concept of "total war" was put into effect and among its components were the objectives of achieving mastery of the skies and isolating the battlefield. Air strikes were also utilized in capturing enemy airports, destroying strategic points and important industries, and even destroying dams. Aerial reconnaissance also became vital for military operations.

f. In the postwar period the same tactics often were employed. Reliance on total air attack became very clear in the India-Pakistani war, as well as the Middle-East wars in 1956, 1967, and 1973. The last Middle-East war saw many significant changes in aerial combat: the importance and effectiveness of ground based surface-to-air missiles and the necessity for defense suppression against a sophisticated electronic threat.

#### The Importance of the Air Force Role in Achieving Victory:

From the beginning of World War II to its end, air power played a major role in the struggle. Hostilities began with massive German air strikes against Poland in 1939

and ended with bombing of Hiroshima and Nagasaki in 1945, and the evidence is strong that air power played a major role in most of the campaigns in between. Most local wars since 1945 yield a similar lesson with the added feature that, in modern war, air power is employed most effectively as part of a combined-arms operation where all services cooperate to accomplish one mission or objective. On the tactical, operational, and strategic levels that exist in an armed conflict, victory can best be achieved through combined forces operations, the application of sound principles, and seizing and holding the initiative. Air power has an important role in each of these levels. In particular, the battles of World War II demonstrated the role of air forces in greatly assisting the other armed units to take and hold the initiative.

**Technology's Effect on the Air Force Role:**

a. Because of the major advances in technology since World War II, often spurred on by the competition between advocates of air power and those stressing air defense, there have been impressive improvements in both air strike and air defense capabilities. For example, today we have high speed airplanes with great range capable of delivering sophisticated munitions on target with great accuracy. On the other hand, air defenses have become much more capable, making the task of executing offensive missions much more

difficult. Making force acquisition, doctrine, and training decisions even more complicated are economic factors, both initial acquisition costs and the continuing costs of maintenance and training.

b. All of these factors impact significantly on the choice of missions and the capability to achieve them.

c. It is clear that the air force's role in achieving victory in any armed conflict is extremely important. Also, we find that the missions which the Air Force has to execute to fulfill its role, and the way the Air Force has to achieve these missions, is different from time-to-time due to the improvements of airplanes and air defense means.

d. By studying the air force's role in different wars, especially those which follow World War II, we find that the following points are crucial:

(1) The success of land and naval forces is predicated on control of the air.

(2) Air superiority is essential to the ultimate elimination of the enemy's land combat effectiveness.

(3) Crucially, the most important (and complicated) mission for the Air Force is to provide close support for the land force's activities.

e. It is against this background and with these particular points in mind that I will approach my thesis. The thesis of this paper is that a well-planned and

well-coordinated effort using air power is essential to accomplish objectives in the face of highly complex air defenses. Planning for this effort can be enhanced by a set of equations and performance factors which account for technological differences in aircraft and provide a forecast or range of expected attrition. When refined, this planning effort could be placed on micro-computer to decrease reaction time while providing increased predictive accuracy. I will analyze the employment of air power to achieve its missions in the operational theater. I will put special emphasis on the concept that in the operational theater air superiority, suppression of air defense, air interdiction, and close air support of land forces are very closely linked. A major key to their achievement is what I call Massive Air Strikes (MAS).

**What is Massive Air Strike (MAS)?**

a. Massive Air Strike (MAS) is the concept of deploying all the available air power in the same time period (a very short period) to accomplish most of the air power missions. MAS would decrease the attrition rate in our airplanes more than if we tried to accomplish each mission independently. Also, MAS gives us the advantage that the enemy in the short time available (MAS period), has a limited capability to use his fighters against our MAS.

b. The concept of MAS depends on the following facts: their objective by directing a series of successful air strikes against the enemy targets in depth, to provide close air support to friendly land forces, and to achieve suppression of air defense in the operational theater.

(2) To achieve the above mission, the air force must achieve and maintain air superiority and concentrate on improving it continuously.

(3) Due to the major advances in air defense means, especially the mobile surface-to-air missiles which accompany the land forces, it has become very difficult to provide close air support by employing a few aircraft without increasing our attrition.

(4) In the present circumstances, it is very difficult to obtain air superiority for the entire battle period by destroying the enemy's airplanes on the ground because of the use of airfield hardened shelters to protect the airplanes. It is also difficult because airplanes can reinforce the operational theater from the reserves or through the allies cooperation. Thus, we have to look practically for only localized or a limited period of air superiority.

(5) To improve the ratio of air superiority for our side, we have to inflict more attrition in enemy fighters through a preplanned air-to-air campaign.

### Planning the MAS:

Because of the large number of airplanes and the requirement to deploy them simultaneously (e.g., in a very short period) against different kinds of targets located relatively in the same area, planning for MAS is a very complicated task and takes a long time. This comprehensive planning process is necessary if it is to provide not only an accurate analysis of the MAS composition but also the expected results and attrition on both sides due to the MAS. In the following chapters I will try to analyze the many elements of this planning process while, at the same time, trying to simplify the process by making it easier, quicker and ultimately more accurate. .

## CHAPTER I

### RECLASSIFICATION OF AIR FORCE MISSIONS

#### Section 1.

##### 1.1 INTRODUCTION:

a. In 1982, the Commanding General of the United States Army Training and Doctrine Command, Glenn K. Otis, wrote that "Air Land Battle is now the doctrine of the United States Army. It states that the battle against the second echelon forces is equal in importance to the fight with the forces at the front. Thus, the traditional concern of the ground commander with the close-in fight at the forward line of own troops (FLOT) is now inseparable from the deep attack against the enemy's follow-on forces. To be able to fight these simultaneous battles, all of the armed services must work in close cooperation and harmony with each other. If we are to find, to delay, to disrupt, and to kill the total enemy force, we will need the combined efforts of the Air-Army team."<sup>1</sup>

b. By studying this statement, we can see that the backbone for victory in the Air Land Battle is the close cooperation and harmony between Army and Air Force Services.

Looking for the best way to enable the Air Force to perform its responsibilities and functions in the Air Land Battle, we have to study deeply the Air Force's missions and the way to fulfill them under the new circumstances in the modern war theater. That theater is very different from the theater of World War II, due to the following reasons:

(1) The advanced technology included in the airframe coupled with the plane's updated navigation and weapons systems, newer munitions including so called "smart" weapons and the increased air defense means now available to ground forces.

(2) The numerous lessons from the wars which followed World War II, especially, in the Middle East and the Falkland Islands, which emphasized the importance of high technology and electronic combat.

1.2 It is necessary to study Air Force missions in the light of the goals we need to achieve from each, and the importance of this achievement to the success of the Air Land Battle. For this purpose, I will put the present Air Force missions in six main classifications as follows, taking the USAF missions as an example:

- a. Strategic Aerospace Missions
- b. Airlift Missions
- c. Aerospace Maritime Operations Missions
- d. Special Operations Missions

e. Aerospace Surveillance and Reconnaissance Missions

f. Tactical Missions

1.3 In this chapter, I will reclassify these missions in the way it will best serve the accomplishment of the Air Force's role in the modern Air Land Battle, looking for the most effective way of employing air power.

## Section 2.

### 2.1 Previous Mission Classifications:

As I said in the previous section, I will take the USAF missions as an example in this thesis. For this reason I will rely on studying "The Basic Aerospace Doctrine of the USAF (AFM 1-1)" to describe the present mission classifications. From this study we find that we can classify the Air Force's missions in the following order.

### 2.2 The Strategic Aerospace Missions:

a. Strategic aerospace missions may be an offensive mission with the objectives of neutralizing or destroying an enemy's war-sustaining capabilities or will to fight. Strategic forces attacks may be directed against an enemy's key military, political, and economic power bases. Or, they may be defensive missions with the objectives of integrating aerospace warning, control and intercept forces in order to detect, identify, intercept, and destroy enemy forces (in any medium) attacking our nation's war-sustaining capabilities or will to fight. The strategic defensive missions enhances the survivability of strategic aerospace offensive forces and protects the key military, political, and economic power bases.<sup>2</sup>

b. By studying these missions, we find that their achievement will have an indirect effect on the Air Land Battle, and in the long run it will effect directly the

capacity to achieve victory of the whole war. On the other hand, it does not have a significant effect on the day-to-day Air Land Battle activities.

### 2.3 Airlift Missions:

a. The objectives of these missions are to deploy, employ, and sustain military forces through the medium of aerospace. These missions are performed under varying conditions, ranging from peace to war. As a combat mission, airlift projects power through air drop, extraction, and air landing of ground forces and supplies into combat zones.

b. Airlift may be performed from a strategic or tactical perspective. Strategic (inter theater) airlift transcends the boundary of any one theater and is executed under the central direction of higher authority, normally in support of a more pervasive or overall effort. In contrast, tactical (intra-theater) airlift is performed within the theater of operations and supports theater objectives through the rapid and responsive movement of personnel and supplies.<sup>3</sup>

c. By studying this mission, we conclude that only tactical airlift directly affects Air Land Battle activities in an operational theater. To secure the deployment of tactical airlift, it is necessary for airlift forces to achieve very close cooperation with the tactical air forces (fighters and fighter/bombers) to protect the tactical

airlift airplanes against the enemy's fighters and air defense means. Tactical forces also provide the airborne ground forces with close air support, especially in the very beginning of their landing.

#### **2.4 Aerospace Maritime Operation Missions:**

a. The objectives of aerospace maritime operation missions are to neutralize or destroy enemy naval forces and to protect friendly naval forces and shipping. These operations may consist of counter air operations, aerial mine laying, reconnaissance and surveillance, and interdiction of enemy Naval surface and subsurface forces, port facilities, and shipping.<sup>4</sup>

b. By studying this mission area we find that it has an effect on the Air Land Battle only if the operational theater includes coastal activities. Also, we can conclude that to achieve this mission one needs air protection. Further, its targets can be considered as part of the air interdiction and/or close air support targets for the theater.

#### **2.5 Special Operations Mission:**

a. The objectives of the special operations mission are to influence the accomplishment of strategic or tactical objectives normally through the conduct of low visibility operations. Covert, or clandestine military actions are usually conducted in enemy controlled or politically

sensitive territories and may complement general purpose force operation. To execute special operations, forces are normally organized and employed in small formations capable of both supporting actions and independent operations with the purpose of enabling timely and tailored responses throughout the spectrum of conflict. Special operations forces may conduct and/or support unconventional warfare, counter terrorist operations, collective security, psychological operations, certain rescue operations, and other mission areas such as interdiction or offensive counter air operations.<sup>5</sup>

b. By studying this mission, we find that in war many of its activities are included in the Air Land Battle's area of operations. Therefore, it must be integrated and coordinated with the other tactical missions in the operational theater.

#### **2.6 Aerospace Surveillance and Reconnaissance Mission:**

a. The objectives of this mission are to collect information from airborne, orbital, and surface-based sensors. These operations provide a wide variety of information that is key to the development of national security policy, force posture, planning actions, force employment, and informed responses in time of crisis. The products of reconnaissance and surveillance operations have strategic and tactical applications in both peace and war;

they also provide timely notification of hostile intent and actions as well as other information vital to the national command authorities and combat commanders.<sup>6</sup>

b. By studying this mission we find that it is an independent mission serving the planning and the employing of all other missions including those which affect the Air Land Battle.

## **2.7 Tactical Missions:**

Tactical missions consist of three main missions. They are:

### **2.7.1 Counter Air:**

a. The objectives of counter air missions are to gain control of the aerospace environment. Its operations are designed to protect friendly forces, ensure the freedom to use the aerospace environment to perform our other missions and tasks, and deny the use of that environment to an enemy. The ultimate goal of counter air is air supremacy.<sup>7</sup>

b. To accomplish counter air's ultimate goal we have to achieve three sub-missions as follows:

(1) Offensive Counter Air (OCA): The aerospace operations are conducted to seek out and neutralize or destroy enemy aerospace forces at a time and place of our choosing. These operations are essential to gaining aerospace superiority and providing the favorable situation which allows us to perform our other missions.<sup>8</sup>

(2) Suppression of Enemy Air Defense (SEAD): Aerospace operations which neutralize, destroy, or temporarily degrade enemy air defensive systems in a specific area by physical and/or electronic attack. The goal of these operations is to provide a favorable situation which allows friendly aerospace forces to perform their other missions effectively without interference from enemy air defenses.<sup>9</sup> This mission can also be achieved by ground forces using field artillery, special operation forces, or armor.

(3) Defense counter air (DCA): Aerospace operations conducted to detect, identify, intercept, and destroy enemy aerospace forces that are attempting to attack friendly forces or penetrate friendly airspace. These operations defend friendly lines of communication, protect friendly bases, and support friendly land and naval forces while denying the enemy the freedom to carry out offensive operation.<sup>10</sup>

(4) An integrated surface-to-air missile net in conjunction with fighters and the requisite command and control support is necessary to achieve success in this mission area.

c. By studying the counter air mission and its sub-missions we find that the counter air mission represents the main, vital, and continuous Air Force role in the Air

Land Battle. Also, we find that its three sub-missions are related to each other. At the same time we find that there is a necessity to coordinate with certain ground force elements activities which achieve success in this mission. Moreover, we cannot achieve any of the sub-missions without achieving the others in the same period of time. For example, if we want to plan an offensive counter air (OCA) mission to neutralize or destroy the enemy's aerospace forces in a particular part in his aerospace environment, we have to plan for SEAD mission in the same period of time to neutralize or destroy his air defense systems which may have an effect on our OCA mission. At the same time, we have to plan for the DCA mission to protect our bases and deny the enemy the capability for carrying out offensive strikes. We also must intercept his fighters which may be pursuing the other two mission forces as they return home.

#### **2.7.2 Air Interdiction (AI):**

a. The objectives of the air interdiction mission are to delay, disrupt, divert, or destroy an enemy's military potential before it can be brought to bear effectively against friendly forces. AI attacks are usually executed against enemy surface forces, movement networks, command, control, and communications networks and combat supplies. Interdiction of the enemy can delay the arrival or build up of forces and supplies, disrupt the enemy's

scheme of operation and control of forces, divert valuable enemy resources to other uses, and destroy forces and supplies. If the AI attacks are against targets which have a near term effect on friendly land forces they are referred to as battlefield air interdiction. This requires joint coordination at the component level during planning.<sup>11</sup>

b. By studying the AI mission we find that it directly impacts on Air Land Battle activities. Also, we find because AI missions penetrate enemy airspace, they require fighter protection. For certain, we will need elements of OCA and perhaps SEAD as we carry out AI missions. DCA is required to protect our own assets from an enemy's attack.

### **2.7.3 Close Air Support:**

a. The objectives of this mission are to support surface operations by attacking hostile targets in close proximity to friendly surface forces. It can be achieved with preplanned or immediate attacks. It requires detailed coordination and integration with the fire and maneuver plans of friendly surface forces.<sup>12</sup>

b. By studying this mission we find that it is designed to support Air Land Battle activities as an additional source of fire power for the surface land forces. Also, we find that it becomes more complicated to conduct close air support in an environment of modern enemy high

threat air defense means which may cause a high ratio of attrition in our close air support forces. Therefore, to achieve secure and effective close air support, we have to plan to achieve most of the counter air operations, especially SEAD, where required.

2.8 From the above analysis of the Air Force missions, and in the light of the Air Force role in the Air Land Battle, the following points are crucial as they relate to the concept of the MAS.

a. The strategic aerospace missions (offensive and defensive), and the aerospace surveillance and reconnaissance missions, are independent. They affect directly the capacity to win the war, but from the perspective of Air Land Battle these missions do not relate directly to its activities and the forces will probably not belong to the theater air power.

b. The airlift and special operations missions may be achieved in peace or in war. If these missions have to be achieved in war in the tactical depth of the operational theater, they will need both coordination and cooperation with theater air power. They will then have a direct effect on the Air Land Battle activities.

c. The tactical missions (counter air, air interdiction, and close air support) and the aerospace maritime operations mission (in the case of coastal

activities) are vital to the success of the Air Land Battle. These missions are closely linked to each other. To obtain an effective and secure achievement for any one mission, we need to carry out most of the other missions. These tactical missions are at the very heart of the MAS and require further analysis to determine their interrelationship in accomplishing theater objectives within the Air Land Battle framework.

### SECTION 3.

#### NEW MISSION CLASSIFICATIONS:

3.1 From the previous section we conclude that in war the airpower role may be divided into three sets of missions as follows:

a. First Set: The missions which have no direct effect on the tactical operational theater (Air Land Battle). These missions are planned independently and contribute to the final results of the war. These missions are planned continuously during the war.

b. Second Set: The missions which have a direct effect on the Air Land Battle. These missions are planned and coordinated with the land forces to support the accomplishment of their goals. This coordination continues from the beginning to the end of the Air Land Battle.

c. Third Set: The missions which are not continuously planned during the war. These missions may be planned and executed for tactical or strategic depth throughout the operational theater. Also, these missions may be accomplished in peacetime.

3.2 By studying each of these sets, from the point of view of its direct effect on the Air Land Battle's progress and its day-to-day activities (which need very close and

efficient coordination and cooperation), we find that each set contains specific missions and sub-missions which require specific forces to be successful.

3.3 a. In the First Set: We find that the strategic aerospace offense and defense missions have no direct effect on the Air Land Battle. The same is true of the aerospace maritime operations (except in the case when the Air Land Battle involves coastal activities. In this case we can consider the sea shore targets as part of the Air Land Battle theater, and to achieve the missions attached to it we use the theater forces).

b. To achieve the strategic aerospace missions (offense and defense) and the aerospace maritime operations we use the long range strategic bombers and the surface-to-surface/sea missiles.

3.4 a. The Second Set: We find that the tactical missions (counter air, close air support and air interdiction) and their sub-missions are directly connected to the Air Land Battle and related to its activities from the start of the planning stage until the end of the battle.

b. To achieve the tactical missions we use the theater forces (mainly fighters and fighter/bombers) stationed in the theater bases.

3.5 a. The Third Set: We find that the airlift, special operations, and Aerospace Surveillance and Reconnaissance

missions are the kinds of missions which may be planned in peace as well as in war. In relation to the Air Land Battle, these missions may be achieved in the tactical or strategic depth of the war theater. Therefore, these missions have to be planned by high level authority and their activity may sometimes be coordinated with the theater forces.

b. To achieve these missions we use transport airplanes or specifically assigned forces, especially designed or trained for their missions.

3.6 The Air Land Battle will have defined borders and its area will be partly occupied by our forces and the rest of the area by the enemy. From this fact we find that all the air force stationed in the Air Land Battle theater must be under one command, applying the principle of unity of command. For the same reason, this Air Force command will be under a theater command. Also, the theater Air Force's missions have to be related to the theater land force's missions, due to the fact that Air Force missions must be coordinated with the land force's activities.

3.7 From the above we can conclude the following results:

a. The missions of the first set and the third set are not directly related to the Air Land Battle and have no direct effect on its activities. The forces may or may not be stationed in the Air Land Battle theater and their activities are planned at a higher level. Also, the

coordination between their activities and Air Land battle activity is limited.

b. The missions of the second set are related directly to the Air Land Battle and their achievement affects the success of the Air Land Battle. These missions use the theater forces to accomplish their objectives which requires very close coordination with the Air Land Battle activities.

3.8 From the study of the above elements we may reclassify the air power missions into two groups of missions as follows:

3.8.1 First Group: Those which have no direct effect on the Air Land Battle and should be directed at a higher level than the theater. This group contains the following missions.

- a. Strategic Aerospace (defense and offense)
- b. Aerospace Maritime Operations
- c. Air Lift (inter-theater)
- d. Special Operations
- e. Aerospace Surveillance and Reconnaissance

Remarks: Some of the above missions may need a coordination with the theater Air Force if their activity will be planned in the theater Air Force's action field. In this case, the forces which have to achieve these missions must work under the theater Air Force command.

3.8.2 Second Group: These are related directly to the Air Land Battle and need a continuous coordination with its activities. This group contains the tactical missions, which are subdivided into:

- a. Air Interdiction
- b. Counter Air
- c. Close Air Support

Remarks: The forces which achieve these missions are known as a theater Air Force. They are stationed in the Air Land Battle theater under one command.

3.9 From the above reclassifications we find that the missions in the first group are independent and need a high authority decision to be achieved. Also, we find that we have enough time to plan for them. On the other hand, we see that the missions in the second group are related to the surface forces activities which are characterized by quick changes and decisive maneuvers. For these reasons, the time available for planning for these missions is relatively short. This demands that this planning be done in the operational theater, by the theater Air Force command, in coordination with the surface force command.

3.10 As a result of the previous analysis, we find that we have to plan to achieve the second group of missions within

the same time frame and in coordination with the surface forces activities. The concept that enables us to achieve this result is the Massive Air Strike (MAS).

## SECTION 4.

### MASSIVE AIR STRIKE CONCEPT:

4.1 The theater airpower role in the Air Land Battle has two main objectives. The first is to support the surface forces activities to help it accomplish the victory. The second objective is to gain, improve, or keep air superiority in the operational theater. The second objective must be achieved in order to accomplish the first objective.

4.2 a. Effective execution of the massive air strike concept will enable us to gain and keep air superiority during large portions of the Air Land Battle and to support the course of actions in the operational theater by directing successive, intensive attacks on well-chosen targets in the shortest time. For this technique to succeed, the attacker must maintain a high level of combat readiness, achieve the element of surprise, mobilize most of his airpower, and assault as many vital targets as possible.

b. Furthermore, there has to be close cooperation with other armed force branches while maintaining a flexible, decisive posture so as to reach the desired level of destruction.

### 4.3 General Composition of MAS:

a. To achieve the first objective of MAS (achieving and maintaining air superiority), enemy air power may have

to be destroyed and neutralized in the air since destroying war planes on the ground has become increasingly difficult due to advanced warning systems and underground, fortified air shelters. To achieve this objective, MAS has to contain a preplanned air-to-air campaign against the enemy interceptors (fighters). At the same time, MAS ground targets must include those which are needed to secure mastery of the sky, such as the enemy warning systems and his command and control posts.

b. To achieve the second MAS objective, the targets to be assaulted will vary according to the desired objectives. These may be: to preempt the planned enemy attack or to isolate the battle ground, to pave the way and soften enemy defenses before the general assault begins (or in any other critical situation affecting the surface force's activities).

c. Due to those factors, the MAS force is divided into three groups. The first, which is estimated to be between 30-40 percent, consists of fighters and fighter-bombers, as well as those aircraft needed for electronic jamming and warning. These war planes are to create the most suitable tactical air conditions and assure air mastery. Second comes the main striking group, which represents 40 to 50 percent of the force. This also contains fighters and fighter-bombers. Its main function is to destroy the

enemy's primary targets. The third segment, approximately 20 percent, provides the reserve and may include some reconnaissance planes.

#### 4.4 The factors affecting planning for MAS:

a. Like any other military operation, MAS planning requires several factors to be taken into account. First, there has to be an accurate assessment and comparison of the forces on both sides, in order to determine the extent of air superiority. If the ratio is at least 1.5 in our favor, it means that our Air Force will be able to achieve its goals.<sup>13</sup>

b. Second, enemy defensive capabilities, including radar, anti-aircraft power, and the skills to use the advanced electronic equipment have to be carefully and realistically evaluated.

c. Third, timing is always crucial. The theater Air Force commander must decide whether the MAS will precede the surface forces attacks or accompany it. In all cases, timing has to be coordinated with the surface force commander, because this, in turn, depends on several factors including the time of surface forces attacks (at dawn, sunset, or at noon, etc). Also, it depends on the weather forecast, how crucial it is to attack the enemy echelons,

how bad the situation is, and many other factors. In any case, the element of surprise has to be assured, that is, one has to attack at the least expected zero hour.

d. Fourth, as I explained before, the targets vary according to the desired objectives, the enemy force structure, and the stage of the combat operation.

e. Finally, the effectiveness of air strikes depend on the size of the striking force, its composition and organization.

4.5 It is quite apparent that the total air strike (MAS) is a very complex operation which requires careful planning, extensive preparation and perfect execution. It is regarded as one of the primary functions of the Air Force that is aimed at weakening and frequently incapacitating the enemy. Hence, a successful MAS must be orchestrated with other military moves in order to achieve the necessary synchronization between theater air power and surface forces, on the drive toward victory.

## CHAPTER 2

### THE MASSIVE AIR STRIKE FORCE

#### SECTION 1: GENERAL FORCE STRUCTURE:

##### 1.1 The Factors Which Affect Building the Most Successful Construction of MAS:

The volume and type of fighters and fighter/bombers (F/Bs) which are available in the operational theater provide the foundation for the calculation and estimation of the probability of success of the MAS. To determine the volume of fighters and F/Bs necessary to participate in MAS, we must consider some of the following factors:

##### 1.2 First: The Factors Which Affect the Needed Fighter's Volume:

a. The time available for enemy fighters from the moment he detects our MAS by his warning means, because this time will affect directly the number of his fighters which can take off to intercept our airplanes. With the increase in this time, the number of enemy fighters will increase. This will demand an increase in the number of our fighters needed to protect the strike F/Bs.

b. The available number of enemy fighters and the portion reserved for the different alert positions. An increase in this number will increase the number of our fighters which need to participate in MAS.

c. The type of enemy fighters and their performance capability (Note: Performance capability includes weapon systems and munitions). For example, the losses in the MAS will be expected to increase if the enemy will use MIG-27s instead of MIG-21s to intercept our airplanes.

d. The capability of the onboard enemy and friendly electronic warfare systems and their effectiveness in degrading the efficiency of the fighters' control, cooperation, and ground radar warning means.

e. The number of our fighters whose mission is to protect the strategic targets in our depth. An increase in this number will affect passively the available fighters we can use in the MAS. Also, an increase in the efficiency of our ground based air defense means (e.g. surface-to-air missiles) will permit us to be less dependent on fighters and increase the number of those we can use in the construction of the MAS.

**1.3 Second: The Factors Affecting the Fighter/Bomber's Numbers:**

a. The number of targets to include: The area covered, individual components most vulnerable to air attack, and characteristics such as soft, medium, hard, sheltered or unsheltered. Also important are the distances

between these targets and our F/Bs' bases. These distances have a large passive effect on the F/Bs' capability to carry armaments as opposed to extra fuel tanks.

b. The enemy's air defense means (radar/missiles sites) and the enemy's command and control posts we have to attack to secure the success of the MAS activities. An increase of these targets' numbers will increase the number of F/Bs needed.

c. The expected losses or attrition caused by all enemy air defense means (fighters, missiles, AAA) during the mission. The more losses expected, the more F/Bs that must participate in the MAS to assure the needed destruction ratio.

d. The special conditions which characterize the action against each target, such as bombing accuracy, number of munitions carried by each aircraft, and the accuracy of reaching the target (which depends on the air crew's efficiency). The more efficient one is with these factors, the less the number of F/Bs needed to accomplish the same results.

e. The F/Bs' performance capability and the accuracy of its navigation and weapon systems. (Again, the term performance capability includes not only aircraft characteristics such as speed, range, acceleration, G-loading, etc., but also onboard weapons systems such as

radar, inertial navigation, etc., and munitions capability usually expressed in both number and type of weapons carried.) The more these are efficient, the less F/Bs we need to accomplish the same result.

f. The destructive force of the available munitions and the F/Bs ability to carry a larger amount of these armaments. Because the targets have different characteristics (See paragraph a. above), the number and type of F/Bs will vary depending upon the target, the desired level of destruction desired, and the type of munitions/armaments available. Thus, the greater number of munitions/armaments per F/B reduces the number of aircraft required.

g. The F/Bs' Tactical Range. With an increase in tactical range, the F/Bs will be able to attack targets in the enemy's strategic depth with a reasonable volume of destructive means. In addition to the increased tactical range, this capability gives more freedom in choosing a safer cross country route in and out. Increased range also permits more flexible navigation to approach the targets and avoid the enemy's air defense means.

## **SECTION 2: THE FIGHTER COMPONENT:**

### **2.1 Calculation of the Numbers and Type of Fighters Necessary to be Stationed in the Operational Theater, is Based on the Following Considerations:**

2.1.1 The number of fighters needed to have a ratio of not less than 1.25:1 to enemy fighters expected along the entire route of flight.<sup>14</sup> This ratio ensures satisfactory losses in the enemy fighters and recognizes acceptable attrition of our forces (as I will clarify in the next chapter).

2.1.2 The number of fighters needed to secure and protect the ground forces and vital targets in our strategic depth and on the secondary directions, against any air hostilities during the MAS period.

### **2.2 To Calculate the Number of Fighters Needed to Participate in MAS Requires a Sequential Process:**

a. Determine the warning time available to the enemy. Warning time translated into an expected number and type of interceptors including the number of his fighters in each standby (alert) position. We can then figure the numbers and types of enemy fighters which we expect to face on every interception line. To clarify this point, we know that the interceptors do their job from standby positions which differ due to the difference in passive time between the

detection and the interception. In periods of increased threat, the objective would be to have continuous protection against enemy attack. This protection is achieved by having the available interceptors in three stages of alert. The first stage is fighters flying CAP and fighters on the ground ready for immediate takeoff. The second stage is those fighters with pilots in alert who can launch but not as quickly as the first stage. The third is the fighters that are in the refueling process.

b. By knowing the coefficient performance capability (Table I) for every type of the enemy's fighters, we can calculate the general ratio of his fighters' performance capability. Hence, we can figure the number of our fighters we have to use in the MAS in general by applying this formula.

$$No_{ff} = No_{ef} \times *_{ef} \times "_{s}$$

which:

$No_{ff}$  = Number of the friendly fighters (in basic units).

$No_{ef}$  = Number of the enemy fighters.

$*_{ef}$  = The general ratio of the enemy fighters performance capability.

$"_{s}$  = The needed coefficient superiority.

c. After figuring the number of our fighters in general basic units ( $No_{ff}$ ) and by knowing the coefficient

performance capability (Table I) of our fighters types, we can determine the number of fighters from each type. The next step is to distribute it among the different echelons of MAS. This distribution depends on the expectation of the enemy fighters combat action doctrine (sequence and numbers). Then we have to plan to distribute our fighters in sequence and numbers in order to accomplish the same coefficient of superiority on each expected interception line during the cross country flight and in the target area.

d. After the calculation of the type and numbers of our fighters and their distribution among the first and second echelons of MAS, the next step is to calculate the number of fighters we need in the reserve echelon (third echelon). The reserve echelon is responsible for protecting the MAS's F/Bs on their way back and during the refueling stage. Also, this echelon is responsible for reinforcing the combat action of the first and second echelon fighters.

e. The volume of the third echelon (reserve) depends on the following elements:

(1) The distance between home cross country (e.g., egress) routes and the distance between our air bases. If those distances are great, we will need more fighters, because the fighters of this echelon are doing their job mainly from CAP status and seek to reinforce combat actions from ground alert positions. For these

reasons the CAP fighters have to be in a position which permits them the proper reaction time to intercept the enemy fighters which may be chasing our F/Bs or attacking our air bases. Hence, we find that there is an increasing ratio between the side distance of cross countries and the number of fighters needed (number of CAP). Since the same thing is true for the distance between the air bases, we will need more fighters to reinforce the CAP's combat actions if the distance between bases exceeds our capability to react within the necessary time constraints to prevent an enemy attack. The size of the reserve echelon is a function not only of distance but also of the detection range of our early warning network and the speed, range, and reaction time of our friendly fighters whether on ground alert, airborne or combat air patrol (CAP).

(2) The expected number of enemy fighters which we estimate will be chasing our F/Bs on their way back. Exceeding this volume will require more of our fighters. This volume depends on the accomplishment of the first and second echelons and their success in neutralizing the enemy's air bases and the number of his fighters losses in air-to-air combat and in our air-to-ground activities against his air bases.

(3) The density and capability of our ground to air means protecting our air bases. If it is strong, we

will be less dependent on our fighters to protect these bases during the recovery reloading and refueling stages.

f. During the process of this calculation we have to consider the fact that we need a number of our fighters to protect the vital targets in our strategic depth and our forces on what can be termed secondary directions or access of possible enemy attack. Most of these fighters will not be available for the construction of MAS due to the their required large radius of action and the short time available to have an active part in any MAS action. The volume of this part depends on the distribution of the vital targets we have to protect, the strength and density of the other air defense means protecting them, and the expected volume of the air threat during the MAS duration and the refueling stage of our fighters.

### SECTION 3: THE FIGHTER/BOMBER COMPONENT:

3.1 Here we estimate the number of F/Bs we need in the construction of the MAS to guarantee its success in accomplishing its goal. This number will consist of the F/Bs which are able to fulfill their missions by accomplishing the needed destruction ratio while at the same time considering the expected losses due to enemy air defense means and fighters before their mission's fulfillment.

3.2 To Estimate the Minimum Volume of F/Bs We Need to Guarantee the Success of MAS, the Following Steps Apply:

a. Calculate the F/Bs needed to act against enemy air defense sites along the ingress, egress routes, and in target area of the main MAS. These targets along with warning means and control posts are key considerations for MAS concept.

b. Calculate the F/Bs volume needed to neutralize the enemy air bases for a certain period of time.

3.3 To figure the number of F/Bs needed to destroy or neutralize any target, we have to study the components of the target, its construction, its area, and its characteristics to decide the kind of munitions, their numbers, the axis of attack and the priority for each main subtarget. Depending on the previous elements and

by knowing the distance between our air bases and the targets, we can calculate the number of F/Bs needed to act on each target considering the probabilities of reaching the targets, the accuracy of weapon systems in different types of F/Bs, and the air crews training standards (e.g., proficiency in carrying out the assigned task).

3.4 During the study of the targets components we attempt to detect the key component the destruction of which will put the target out of order. As an example, when we are acting against command posts, it is more effective and economical if we attack their group of antennae than if we try to destroy the command post area. Also, if we decide to attack the antennae, it is wise to use fragmentary bombs instead of high explosive bombs. As another example, when we are planning to attack radar site, its better to use so called "smart" missiles which seek the sites emitting electro magnetic waves instead of trying to destroy the entire area. In the previous examples, the number of F/Bs will depend upon the number of specific armaments/munitions, we can carry on each aircraft as well as the number of the antennae we need to destroy.

3.5 One of the very important targets for MAS is the enemy air base. While we are acting against these air

bases, we are not trying to completely destroy the aircraft shelters or the runways as I explained before, but we are looking to neutralize these bases for a certain period of time. In other words, our objective is to prevent enemy fighters and F/Bs from using the airfield for a calculated time. To do that we have to study the enemy capability for recovery (How many holes in the runway can he recover per hour?). By knowing his rate of recovery, we can calculate the proper number of F/Bs we need to neutralize his air bases for a certain period of time, which I suggest to be 4-5 hours for the following reasons:

a. The period of 4-5 hours gives the ground and air forces a better opportunity to advance against the enemy. If the MAS is in the morning, a second strike could be scheduled for the afternoon. If MAS is in the afternoon, the enemy would not regain use of the bases before sundown.

b. The period of 4-5 hours permits us time to refuel and reload and then conduct another MAS.

c. If we try to plan for exceeding the neutralization time to be greater than 4-5 hours, it will take a larger group of F/Bs, but they will be exposed to enemy defenses. Therefore, they may suffer from attrition. And if we

planned for less than 4-5 hours, it does not do us any good because it doesn't satisfy our objective nor permit us time to be ready for another MAS.

d. After consideration of the above elements, we can determine the neutralization period quite precisely by our refuel and reload capability, the sunset time and the enemy capabilities to recover the use of his air base.

3.6 The key to the calculation of the needed destruction forces (number of F/Bs) is to consider the ability of the enemy to recover his destroyed air bases, assuming that he will first concentrate on repairing the main runway or the subrunway depending on which has the least damage.

## CHAPTER 3

### PLANNING FORCE APPLICATION

#### SECTION 1: INTRODUCTION:

1.1 Planning for MAS is a very complicated process because it requires accurate calculations in a relatively short period of time. This is especially true when we plan to direct the MAS during combat.

1.2 The Complexity of Planning for MAS is a Result of the Following Elements:

a. Every time we conduct a MAS, we have to plan to use almost the entire theater air force (fighters (Fs) and fighter/bombers (F/Bs)) in the same period of time in the whole operational theater, with different loading configuration.

b. The variety of targets then subcomponents and locations. Also, the difference in the needed ratio of destruction for one target relative to another.

c. The difference in the strength of air defense systems means that protect each target; this factor affects our expected losses and the way we attack each target.

d. The importance of coordination among the cross country missions for all MAS's airplanes. Also, the detailed coordination with the surface forces and surface air defense means to secure the MAS activities.

e. The importance of coordinating with other fire power sources in the operational theater to allocate the proper targets to the proper fire power source.

1.3 As stated in Chapter I Section 4, one of the MAS main objectives is to gain, improve or keep air superiority in the operational theater. It is very important to know what is the exact coefficient of superiority before starting any planning process. To do that we have to continuously compare the two sides air forces.

1.4 It is vital to determine the expected results of MAS when putting it before the commanders who possess the authority to direct the MAS, especially the expected attrition on both sides. It is important to try and estimate the losses on both sides to determine the effectiveness of MAS on the coefficient air superiority.

1.5 To clarify the suggested way of planning the MAS, I will suppose an example for our theater air force and the enemy air force in the theater by numbers and type. In this chapter I will do the planning step by step through four sections, starting with the comparison between both sides air forces, then the planning process, the expected results of MAS, and ending with how the MAS contributes to the primary mission.

SECTION 2: THE COMPARISON BETWEEN BOTH SIDES AIR FORCE:

2.1 Due to the vital role of air power in any modern war, we find that every country in the world gives a high priority to equipping her air force with the best air possible planes. For this reason, we do not depend upon only the number of aircrafts the country has as an indication of its air force strength. In measuring the fighting efficiency of any air force it is also very important to consider other factors as follow:

a. The average of serviceability (men capable rate): This depends on the ground technical crew's efficiency and the availability of the technical, equipment and instruments. The normal average MC rate for a combat ready service in times of tension is between .8 to .9.

b. The fighting efficiency factor: It differs from one type of aircraft to another and is expressed by a relative number to a chosen standard aircraft. It is the result of the fighting and technical characteristics for the aircraft. The fighting efficiency factor for any aircraft has two numbers. One of them represents its air-to-air fighting efficiency and the other represents its air-to-ground fighting efficiency in relation to the other aircrafts. This factor depends on the aircraft performance, its on board navigation, weapons, radar, and ECM systems,

and its capability to carry different kinds of effective weapons. As an example of how we would calculate this factor, we would choose any aircraft and consider it as the standard one. Suppose that it is a MIG 21. To figure the fighting efficiency factor for an F-16 in an air-to-air role we compare their performance, their on board systems, and their capabilities to carry effective weapons. This comparison is only concerned with the elements which affect their air-to-air capabilities. During the comparison process we suppose that the standard aircraft (MIG 21) is equal to one in each element and give the other aircraft (F-16) a relative point to one. By adding the all points and dividing by the number of comparison elements we find that the standard aircraft will equal to one and the other aircraft will have a specific number. In our example the MIG 21=1 and the F-16 =2. It means that the fighting efficiency of aircraft F-16 is double that of MIG 21. In other words, the fighting efficiency of four F-16 is equal to that for eight MIG 21s regardless of the economic factor or the pilot's standards. The process of figuring this factor needs expertise and experience. It is also a continuous process because any modification in any aircrafts elements of comparison will change its factors. Table #1 includes the fighting efficiency factors of some types of aircraft. We will use its data in this chapter.

c. The training level of the aircrews is very important and has a significant effect on the comparison results, but to simplify the process, I will consider that this factor is equal on both sides. Quantifying training between air forces is an almost impossible task. Subjective judgements by experienced pilots are the best you can do in this area.

d. The ECM capabilities, the air defense system efficiency, and the control posts' capabilities affect the comparison results, but again for the same reason of simplification I will consider that both sides have equal or identical capabilities.

**2.2 Fighting efficiency comparison is best expressed by a series of mathematical calculations. As an illustrative example I will suppose that:**

a. The enemy air force is composed of the following volume of Fs and F/Bs:

120	MIG 21
140	MIG 23
120	MIG 25
180	SU-20 & 22
<u>24</u>	TU-22
584	TOTAL

b. In addition, the enemy has 4 early warning aircraft and 18 reconnaissance aircraft (MIG 23 & MIG 25). This means that the enemy's total air force (neglecting the transport and helicopters) contains 606 aircraft:

Our air force is composed of the following volume of Fs and F/Bs:

160	F-15
240	F-16
<u>160</u>	F-4
560	TOTAL

c. In addition, we have 4 E-3s and 24R F-4s. This means that our air force (neglecting the transport and helicopters) contains 588 aircraft.

d. **STEP 1:** Knowing that the enemy is using the following types:

MIG 21 - MIG 23 - MIG 25 - SU - 20 & 22 - TU - 22. From Table #1 we can conclude the following information about aircraft fighting efficiency factors:

Aircraft Type					
Mission	MIG 21	MIG 23	MIG 25	SU 20,22	TU 22
Air to Air	.88	1.4	2.3	1.3	-
*Air to Ground	1	1.65	-	1.7	2.4
Reconnaissance	-	-	2.5	-	-

\*After the modification of putting two (2) pylon on the aircraft MIG 21, its air-to-ground capability improved at the expense of its air-to-air capability.

e. **STEP 2:** Calculation of the fighting efficiency of enemy fighters: We expect that the enemy will use 60% of his fighting aircraft (350 aircraft) as fighters, as follows:

120	MIG 21
110	MIG 23
<u>120</u>	MIG 25
350	TOTAL

Using the fighting efficiency factors in step one, we make the next table:

Type of Fighters The Process	MIG 21	MIG 23	MIG 25	The Total No.
No of aircraft of the type;	120	110	120	350
The ratio of the type to the total fighters	0.343	0.314	0.343	1.00
The fighting effi- ciency factor	0.88	1.4	2.1	-
The ratio X the factor	0.3018	0.4399	0.7889	1.5306

From the above process, we find that the enemy fighters' fighting efficiency = 1.53.

f. **STEP 3:** Calculation of the fighting efficiency of enemy F/Bs:

By using Table #1 and the enemy F/Bs volume (40%), 234 aircraft are distributed as follows:

30	MIG 23
180	SU-20 & 22
<u>24</u>	TU-22
234	

The enemy F/Bs' fighting efficiency:

Type of Fighter/Bomber				The Total
The Process	MIG 23	SU 20 & 22	TU 22	No.
No of aircraft of the type	30	180	24	234
The ratio of the type to the total F/B	0.128	0.770	0.102	1.00
The fighting efficiency factor	1.65	1.7	2.4	-
The ratio X the factor	0.2112	1.3090	0.2461	1.7663

From the above process we find that the enemy F/B fighting efficiency = 1.77

g. STEP 4: From the previous, it is possible to summarize the available information about the enemy fighting aircraft as follows:

(1) The enemy has 350 fighter aircraft whose fighting efficiency = 1.53.

(2) The enemy has 234 F/B aircraft whose fighting efficiency = 1.77.

h. STEP 5: The calculation of our fighters' fighting efficiency.

Using the fighting efficiency factors in Step 1, we make the next table:

Type of Fighters	F-15	F-16	The Total No.
No. of aircraft of the type	160	180	340
The ratio of the type to the total fighters	.471	.529	1.00
The fighting efficiency factor	2.5	2.00	-
The ratio X the factor	1.178	1.058	2.236
From the above process, we find that our fighters' fighting			

efficiency = 2.24.

i. STEP 6: The calculation of fighting efficiency for our F/Bs: Using Table #1 and our F/Bs' volume, we follow the next step:

The expected volume (40%) of 220 aircraft:

60	F-16
<u>160</u>	F-4
220	

Our F/Bs' fighting efficiency:

Type of Fighter/Bomber	The Total		
The Process	F-16	F-4	No.
No. of aircraft of the type	60	160	220
The ratio of the type to the total F/Bs	.273	.727	1.00
The fighting efficiency factor	2.00	1.78	-
The ratio X the vector	.546	1.294	1.840

From the above process, we find that our F/B fighting efficiency = 1.84.

j. **STEP 7:** From the previous, it is possible to summarize the available information about our fighting aircraft as follows:

(1) We have 340 fighter aircraft whose fighting efficiency = 2.24.

(2) We have 220 F/B aircraft whose fighting efficiency = 1.84.

k. **STEP 8:** From the above, we can figure the comparison in number as follows:

Kind of Aircrafts	The Friendly Side	The Enemy Side	The Ratio of Numbers
Fighters	340	350	1: 1.03
Fighter/Bombers	220	234	1: 1.06
Total	560	584	1: 1.04

From this comparison, we can say that the ratios are almost equal for both sides.

REMARKS: The comparison in numbers is important but we cannot depend on it as an indicator of superiority because we also must consider the fighting efficiency of the aircraft type. To calculate the factor of superiority we use the following formula.<sup>15</sup>

Coefficient of Superiority =

$$= \frac{\text{aircraft number (A)} \times \text{serviceability (A)} \times \text{the average aircraft fighting efficiency vector of (A)}}{\text{aircraft number (B)} \times \text{serviceability (B)} \times \text{the average aircraft fighting efficiency vector of (B)}}$$

✓ the fighting efficiency vector of (A)

✓ the fighting efficiency vector of (B)

l. STEP 9: To determine the coefficient of fighters' superiority, we find that it is equal to:

$$= \frac{340}{350} \times \frac{.85}{.85} \times \frac{\sqrt{2.24}}{\sqrt{1.35}} = \frac{509}{407} = 1.25$$

m. STEP 10: To determine the coefficient of F/Bs' superiority, we find that it is equal to:

$$= \frac{220}{234} \times \frac{.85}{.85} \times \frac{\sqrt{1.84}}{\sqrt{.177}} = \frac{298}{311} = 0.96$$

**REMARKS:** In the above calculation, I need only the factors attached to aircraft (number of aircraft, average of serviceability, fighting efficiency factors) on both sides. To simplify the equation, I considered that the other factors were equal on both sides, such as the air crews' training standard, the aircraft daily rate mission capable rate.

n. STEP 11: The next table summarizes the comparison between the fighting aircraft on both sides:

Kind of Comparison	Number Comparison			General Comparison		
	Friendly	Enemy	Ratio	Friendly	Enemy	Ratio
Kind of aircraft						
Fighters	340	350	0.97:1	1.25	1	1.25:1
Fighter/ Bombers	220	234	0.94:1	0.96	1	0.96:1

2.3 By reviewing the above table we find:

a. The ratio number for our fighters to the enemy fighters is 0.97:1, but by considering the fighting efficiency factor, it changed to 1.25:1 for our advantage. This means that our fighters have a relative fighting efficiency advantage.

b. The ratio number for our F/Bs to the enemy F/Bs is 0.94:1, but by considering the fighting efficiency factor, it changed to 0.96:1. This slight improvement is due to the fact that our F/Bs have a fighting efficiency advantage, but it is not as significant as it is in our fighters.

2.4 To determine the general coefficient of superiority we follow the next steps:

a. Calculation of the general fighting efficiency factor for the enemy aircraft:

Aircraft Type The Process	MIG 23		MIG 23		SU	TU	Total
	MIG 21	(F)	(F/B)	MIG 25	20-22	22	Aircraft No
No of aircraft type	120	110	30	120	180	24	584
The ratio of the type to the total aircraft	.205	.188	.051	.205	.308	.041	1.00
The fighting efficiency factor	.18	1.4	1.65	2.3	1.7	2.4	-
The ratio X the factor	0.181	0.263	0.008	0.474	0.524	0.098	1.548

The general fighting efficiency factor for all enemy fighting aircraft (both Fs and F/Bs) = 1.55.

b. Calculation of the general fighting efficiency factor for our aircraft:

Type of Fighters				Total
The Process	F-15	F-16	F-4	Aircraft No.
No of aircraft of the type	160	180	220	560
The ratio of the type to the total fighters	.285	.382	.393	1.00
The fighting efficiency factor	2.5	2	1.78	-
The ratio X the factor	0.713	0.644	0.700	2.057

The general fighting efficiency factor for all our fighting aircraft = 2.06.

Then, we can determine the general coefficient of superiority as follows:

General Coefficient of Superiority

$$= \frac{560 \times .85 \times \sqrt{2.06}}{584 \times .85 \times \sqrt{1.55}} = \frac{803.75}{727.07}$$

$$= 1.11 \text{ (for our advantage)}$$

This means that the comparison between both sides air forces is 1.11:1 to our advantage. This is a suitable ratio to direct a MAS as I mentioned in Chapter 2.

### SECTION 3: THE PLANNING PROCESS:

3.1 To start planning, we have to consider three main elements before we go farther into the calculation of the MAS structure. These elements are:

- a. The time of directing the MAS.
- b. The targets of the MAS.
- c. The volume and the formation of the MAS.

#### 3.1.1 The Time of Directing the MAS:

a. By studying the geographic position of the operational theater we can figure the difference in time between sunrise (first light) and sunset (last light) in the area of our air bases and the target area.

b. If the enemy targets are located to the east of our air bases it means that the first and last light will start earlier in the enemy target area than in our air bases area. And the opposite is true if the enemy targets are located to our west.

c. By considering the time needed for takeoff, assembling and for cross-country, we conclude that it is virtually impossible to direct the MAS in the first light if the enemy targets are located to the east. The minimum time to direct it is equal to the time we need to take-off and fly to the targets plus the difference in sunrise time

between the two locations. (Our airplanes cannot now take-off and fly in formation in the night time, especially with such large number as the MAS.)

d. But because the sunset will happen early on the targets located to the east and by considering the time needed to fly back, dismiss and land, and the difference in sunset time between the two locations, we conclude that the best time to direct MAS against the targets located to the east is approximately the last light. (In this case, we will avoid the enemy fighters which cannot intercept our MAS unless they possess night fighters or a complex, integrated air defense system.

e. If the enemy targets are located to the west of our location, the opposite situation will exist. The position of the sun on the horizon has a passive effect on pilot's ability to detect targets. Fighter pilots like the sun at their back. It makes them more difficult to see from the ground and targets easier to see from the air. Thus, for targets in the east, MAS in the afternoon. For targets in the west, attack primarily in the morning. Study about the weather in the operation theater all the year by seasons, by day, and by daily times which lists many meteorological factors such as: visibility, temperature, dew point,

humidity, present moon illumination, probability of dust storms, etc., which effect on the future "smart weapons".

f. When we are deciding the time of directing the MAS, we have to consider the time of day as it related to the season of the year at both, our air bases and enemy targets. Weather sometimes has a significant passive effect on the MAS results, especially those phenomena which affect the ability to take off and land, such as visibility. That is why it is very important to have a historical data study about the weather in the operational theater all year by seasons, by day, and by daily times which list many meteorological factors such as visibility, temperature, dewpoint, humidity, percent moon illumination, probability of dust storms, etc. Weather phenomena may have a significant effect on future "smart weapons".

### 3.1.2 The Targets of the MAS:

a. When planning to direct MAS, it is important to locate the enemy air bases from which he can intercept the MAS and then plan to attack them as priority targets.

b. The enemy always defends his air bases and his vital targets by powerful air defense. Therefore, if we can't circumvent his defenses, we need to plan to attack them in the first stage of MAS (roll back defenses).

c. It is important to give priority to attacking the enemy early warning airplanes and their strategic bombers. These are important because of their capability for early warning detection and the capability to bomb targets in our own strategic depth.

d. One of the critical targets is the enemy's radar sites and his command posts. By attacking them we can destroy his ability to control and direct his interceptors.

e. As part of a roll back campaign, we have to plan to attack his targets, following these priorities:

- (1) Early warning aircraft in the air
- (2) Radar sites
- (3) Air defense missile sites (those which can't be circumvented)
- (4) Command and control posts
- (5) Early warning aircraft on ground
- (6) Bomber bases
- (7) F/B bases
- (8) Interceptors bases

**REMARKS:** I put on the top of the priorities above, the early warning aircraft in the air to limit the enemy capability to intercept our MAS, since these aircraft increase the enemy's warning time and give him the opportunity to use more fighters to intercept our MAS.

Also, by attacking these aircraft, we will limit the enemy's fighter control. In other words, attacking these aircraft will affect directly the range of MAS' success and the expected attrition.

f. The enemy's electronic warfare means affect passively MAS activity. We have to plan to counter it either passively or actively.

g. As I mentioned before in Chapter 3, the enemy uses hardened shelters to protect his aircraft. Therefore, we have to plan to attack the runways, the sub-runway, and the aircraft shelters' entrances. Here accurate calculation and planning is very important, considering the shortest takeoff run for the enemy's fighters, the penetration depth of our bombs, the number of hits we need, and the distance between these hits to deny him a minimum operating runway length.

### 3.1.3 The Volume and Formation of MAS:

a. Because the enemy has early warning capability, it allows him to use his fighters in different standby positions to intercept our MAS. Because he possesses a variety of air defense means, we plan to have the first echelon of MAS consist of a high number of fighters and F/Bs.

b. During the planning process we have to consider the need for holding in reserve an adequate number of fighters that will not participate in the MAS to use for the protection of our strategic depth's targets during the MAS period, especially if the enemy has a number of his F/Bs in a state of continuous readiness. This volume of fighters will affect the fighters we will use in the third echelon.

**3.2 After studying the main elements which have an effect on the MAS' structure, we follow the next steps to continue our planning procedure :**

a. Determination of the volume and type of fighters needed in the three echelons of MAS.

b. Determination of the volume and type of fighter/bombers needed for the first echelon (secure echelon).

c. Determination of the volume and type of fighter/bombers needed for the second echelon (main echelon).

d. Determination of the way to build the MAS echelons.

**3.3 Determination of the Volume and Type of Fighters Needed in the Three Echelons of MAS**

3.3.1 To Calculate the Needed Fighters in the Three Echelons We Follow These Steps:

a. For the determination of the numbers and types of our fighters in the three echelons, we have to figure the number and types of the enemy's fighters we expect to face on every potential interception line, putting in our consideration the coefficient of superiority we need to achieve our objective against his fighters.

b. The total volume of the enemy fighters (as I supposed in Section 2) which he can use to intercept our MAS, and by supposing that his serviceability, (or mission capable rate) is .9, will be 316 interceptors (108 MIG 21s, 100 MIG 23s, 108 MIG 29s).

c. We expect that the enemy will distribute his fighters among the different standby positions (as I explained in Chapter 2) due to his stations bases (Attachment 1) as follows:

(1) 24 aircraft (MIG 21s) in CAP position to intercept at Interception Line (IL) #1.

(2) 84 aircraft (48 MIG 21s, 36 MIG 23s) in the first case standby position to intercept at IL #2.

(3) 104 aircraft (24 MIG 23s, 80 MIG 25s) in the second case standby position to intercept at IL #3.

(4) 108 aircraft (28 MIG 21s, 32 MIG 23s, 20 MIG 25s) in the third case standby position to direct protection his targets.

**REMARKS:** Only 80 aircraft can takeoff before our fighter/bombers attack the enemy bases, then 24 aircraft stationed at bases (A and C) cannot takeoff (Attachment 2).

d. From the above expectation, we find that the enemy fighters which we expected to face the MAS on the different interception lines are:

I. Line	No of Aircraft	Type	Coefficient of Air/Air Fighting Efficiency	The Fighting Efficiency for Aircraft (Capability Unit.)	
First	24	MIG 21	.88	21	21
Second	84	48 MIG 21	.88	42	92
		36 MIG 23	1.4	50	
Third	104	24 MIG 23	1.4	34	218
		80 MIG 25	2.3	184	
Over Targets	80	28 MIG 21	.88	24	115
		32 MIG 23	1.4	45	
		20 MIG 25	2.3	46	
Total	316	-		446	

e. I explained in Chapter 2 that a superiority coefficient of 1.25 is postulated as sufficient to achieve a considerable superiority over enemy fighters. To achieve this superiority on every interception line, we follow the next steps:

(1) Determine the number of fighters we need to protect the strategic targets in depth in cooperation with the other air defense means. We will suppose the number is 22 aircraft (F-15s) and 12 aircraft (F-16s).

(2) By supposing the serviceability ratio is .9, then the total available fighters = 306 (144 F-15s, 162 F-15s, 150 F-16s).

(3) The next table will explain how we can distribute our fighters on the different interception lines.

I. Lines	Enemy F-E Capability Unit	Superiority 1.25 Needed	Type of Aircraft	Coefficient of Air/Air Fighting No	
				Efficiency	Aircraft
First	21	26	F-16	2	13
Second	92	115	F-15	2.5	14
			F-16	2	40
Third	218	273	F-15	2.5	56
			F-16	2	67
Over Targets	115	144	F-15	2.5	42
			F-16	2	20
Total	446	558	F-15	2.5	112
			F-16	2	140 252

f. From the above table we find that we have 20 aircraft (10 F-15s, 10 F-16s) we can use as the third echelon of MAS to protect the MAS airplanes on their way back. This echelon will do its job from the airborne standby position (CAP). In addition, 34 aircraft (22 F-15s, 12 F-16s) will protect the forces and targets in the depth.

3.3.2 Our first and second echelons fighters will be distributed on the basis of the expected enemy fighters to be faced by each echelon and the 1.25 superiority coefficient. Due to that, we find that the first echelon fighters will face the enemy fighters on the first, second, and third interception lines, and the second echelon fighters will face the enemy fighters in the target area during the main fighter/bomber activity.

3.3.3 From all the above, we can summarize the fighter distribution as follow:

The Echelon No. and Type of Aircraft	Secure					Main Echelon	Reserve	Protection of Targets In Depth			
	Total Aircraft	190					62	20	34		
Aircraft No. From Each Type	13	14	40	56	67	42	20	10	10	22	12
Type of Aircraft	F-16	F-15	F-16	F-15	F-16	F-15	F-16	F-15	F-16	F-15	F-16
Interception Line No.	1	2	2	3	3	Over Targets	Umbrella In the Way Back		Umbrella In The Depth		

3.3.4 Fighters in MAS will achieve their mission using the following methods:

a. Secure echelon fighters will achieve their mission using free hunt methods in front of the other formations by 1.5.2 minutes and third interception lines, by 13 F-16s, 14 F-15s, and 40 F-16s, 56 F-15s, and 67 F-16s in sequence.

b. Main echelon fighters will achieve their mission by direct protection for the fighter/bombers in the same echelon all the way in and out. This will require 42 F-15s and 20 F-16s.

c. Reserve echelon fighters will achieve their mission to secure the return of the MAS by occupying CAP on the home routes of MAS. This will be accomplished by 10 F-15s and 10 F-16s. The CAP occupation will be short time (2-3 minutes) before the MAS aircrafts reach the selected areas.

d. The fighters which will protect the targets in the strategic depth from the different standby positions will be 24 F-15s and 12 F-16s in cooperation with the secure echelon fighters after they land and refuel.

**3.4 Determination of the Volume and Type of Fighter/bombers in the secure echelon (the First Echelon):**

3.4.1 To achieve a successful attack against the main enemy targets, we have to insure the main fighter/bombers' activity by executing the mission of attacking both the enemy air defense means (radar sites, ground-to-air missile sites, and the fighters on the ground) and protecting the command and control posts.

3.4.2 To Determine the Volume and Type of Fighter/Bombers in the Secure Echelon, we follow the Next Steps:

a. Determine the volume and type of F/Bs needed to destroy the enemy radar sites, especially those which are located on the direction of the MAS's cross country (in and out).

b. Determine the volume and type of F/Bs needed to destroy the surface-to-air missile sites.

c. Determine the volume and type of F/Bs needed to close the main (standby) runways of the enemy air bases.

d. Determine the volume and type of F/Bs needed to neutralize the enemy command and control posts.

3.4.3 The MAS route to the objectives will determine the number of E.W. targets hit. For our example we will use nine radar sites to show the effect on force calculations. By destroying nine radar sites, we will achieve a low probability of the enemy detecting our MAS aircraft in and out (Attachment 2). Also, we will decrease the enemy capability of directing and controlling his interceptors to engage the MAS. From Table 2 we find that to destroy nine radar sites we need 18 F/Bs loaded with radiation seeking air-to-ground missiles.

3.4.4 In our example, the enemy defends his air bases by two surface-to-air missile sites each. Due to the fact that we supposed that the enemy has three effective air bases, then we need to destroy six surface-to-air missile sites (Attachment 2). Also, by studying the locations of the other sites, we find that we need to have an additional 50% capability against mobile SAMs (fog/confusion of war).

Thus, the total missile sites we need to plan for are nine sites. From Table 2 we find that we need four F/Bs to neutralize each. Therefore, the total F/Bs is 36 loaded with Maverick missiles and high explosive bombs or rocket cluster (RPF) bombs.

3.4.5 we need to neutralize the main two command and control posts, which will affect the enemy's capability to direct his interceptors (Attachment 2). From Table 2, we find that to neutralize each post we need six F/Bs. Hence, we need 12 F/Bs loaded by RPK bombs.

3.4.6 We need to close the three main enemy bases to prevent his interceptors from taking off to intercept the MAS aircrafts. We find that these bases have 14 standby (or alert) positions. We need to make at least two holes in the runway before each. From Table 2, we find that to accomplish this mission we need 2 F/Bs for each standby position, each F/B loaded with 12 high drag bombs or parachute bombs.

3.4.7 From the Above We Can Summarize the F/Bs We Need for the First Echelon (Secure Echelon as Indicated in the Following Table:

Information Target	No of Targets	Aircraft Numbers and Type	Loading	Mission
Radar Sites	9	18 F-4	Radiation Seeking Missiles	Destroy
Missile Sites	9	36 F-4	Maverick and High Explosive or Rock- eye cluster	Destroy
Standby Positions	14	28 F-16	High Drag or Parachute Bombs	Close air Bases
Command and Control Posts	2	12 F-16	Rockeye Cluster Bombs	Neutralize
Total	-	94		-

**3.5 Determination of the Volume and Type of Fighter/Bombers in the Main Echelon (the Second Echelon):**

3.5.1 The expected number of available F/Bs assuming that the serviceability ratio is .9 is equal to:

The total number  $X .9 = 220 X .9 = 198$  (144 F-4, 54 F-16)

The available F/B for the main echelon =  $198 - 94 = 104$  aircraft  
(90 F-4s, 14 F-16s)

3.5.2 The Main Targets as We Supposed Before:

- a. Three air bases
- b. Two navy bases
- c. Two heavy artillery positions
- d. Tank company

3.5.3 To neutralize the three air bases for a five hour period and by considering the number of runway, subrunway the shelters entrances and the number of holes we need at each base, we can determine the number of F/Bs we need for the mission. Target study drives the actual mission requirements for this paper, the following are representative numbers:

- a. For base (A) 28 F/Bs loaded with high drag bombs
- b. For base (C) 32 F/Bs loaded with high drag bomb
- c. For base (E) 26 F/Bs loaded with high drag bomb

If we consider that there are 28 F-16s to attack these bases in the secure echelon, then we need 58 F-4s (base (A) 20 and base (C) 20 and base (E) 18).

3.5.4 To attack two navy bases we need 12 F-4s for each only loaded with maverick missiles and high explosive bombs.

The total F/Bs needed to attack the navy bases is 24 F-4s.

3.5.5 From Table 2 we determine that each artillery position requires 8 F/Bs loaded with maverick missiles and high explosive bombs to be neutralized. The F/Bs needed are 8 F-4s and 8 F-16s.

3.5.6 By adding the F/Bs needed from the above calculation, we will find the following:

F-4 =  $58 + 24 + 8 = 90$  aircraft

F-16 =  $8$  aircraft

Then the available F/Bs:

$90 - 90 = 0$  F-4s

$14 - 8 = 6$  F-16s

From Table 2 we see that the number of F/Bs needed to neutralize the tank company is 12 F-16. Thus, the 6 F-15s will achieve 50% of the mission.

### 3.6 Determination of the Way to Build the MAS Echelons:

3.6.1 The Following Table Clarifies the Distribution of Fighters and F/Bs Among the Targets:

Aircraft Type	No of Aircraft				The Echelon
	F-15	F-16 (F)	F-16 (F/B)	F-4	
<u>Fighters</u> Engage Enemy Fighters on I.L. No 1		13			Secure
<u>Fighters</u> Engage Enemy Fighters on I.L. No 2	14	40			Secure
<u>Fighters</u> Engage Enemy Fighters on I.L. No 3	56	67			Secure

Engage Enemy Fighters	42	20		Main
Destroy (9) Radar Sites			18	Secure
Destroy (9) Missile Sites			36	Secure
Neutralize (14) Standby Position			28	Secure
Neutralize (2) Command and Control Posts			12	Secure
Protect SAM in Its Way Back	10	10		Reserve

Neutralize Base (A)				20	Main
Neutralize Base (C)				20	Main
Neutralize Base (E)				18	Main
Attack Navy Base (1)				12	Main
Attack Navy Base (2)				12	Main
Neutralize Artillery Position No 1			8		Main
Neutralize Artillery Position No 2				8	Main
Neutralize Tanker Company 508			6		Main
TOTAL	122	150	54	144	470

The number of fighters to protect the strategic depth not included in the MAS.

3.6.2 The MAS contains not only fighters and F/Bs but it also must include the early warning aircraft (AWACs). These aircraft are very important because of their role in directing the MAS F/Bs and the controlling of its fighters activity during the air-to-air fighting (especially those which may happen in the enemy depth, away from our ground radar coverage). Two good examples are what happened in 1981 when the US Navy shot down two Libyan SU-22s in the Gulf of Sider and in 1983 during the Israeli raid on the Syrian surface-to-air sites in the Bebloa Valley in Lebanon. We have to plan to employ two AWACs to support the secure echelon (first echelon) during MAS activities.

3.6.3 To obtain the desired results of MAS, we should use two RF-4s for each enemy air base and naval base to photograph the results which are needed for planning the second MAS. These aircrafts will follow the F/Bs formation of the main echelon (second echelon) and will be part of it.

3.6.4 From all the above, we can conclude that the total number of aircraft which should participate in the MAS is 482, distributed in the different echelons as follows:

a. The secure echelon:

190 fighters (70 F-15s & 120 F-16s)

94 fighter/bombers (54 F-4s & 40 F-16s)

2 AWACs (Note: These aircraft do not fly in the same formation. Rather, they are positioned to provide radar early warning information for the secure echelon.)

b. The main echelon:

62 fighters (42 F-15s & 20 F-16s)

104 fighter/bombers (90 F-4s & 14 F-16s)

10 reconnaissance (10 RF-4s)

c. The reserve echelon:

20 fighters (10 F-15s & 10 F-16s)

Also, there should be 34 fighters (22 F-15s & 12 F-16s) to protect the forces and targets in the strategic depth.

3.6.5 The elements to consider when distributing fighters and F/Bs:

a. The time between the secure echelon's fighters when crossing the enemy radar field must not exceed the interval between the takeoff time of the enemy fighters in the different standby positions. This is to prevent the enemy from reacting quickly to our MAS and massing fighters to blunt the attack. If he is able to do this, then we have lost our relative superiority ratio at every interception line.

b. The fighter/bombers which act in the same area should be of the same type and from the same location. This is desired to make planning at the tactical level much easier.

c. Allocate the proper F/Bs to the proper targets (tactical range-maneuver-munition).

d. All F/Bs must be loaded in addition to their air/surface munition with effective air/air missiles for self defense, should the need arise.

**SECTION 4: THE EXPECTED RESULTS OF MAS:**

**4.1 The expected aircraft losses during the air-to-air campaign depend largely on the following elements:**

- a. The number of aircraft from each side.
- b. The type of aircraft and their fighting efficiency capability.
- c. Other variable elements (pilots training level, command and control capability, fighter control efficiency and missile reliability . . .)

The variable elements are beyond the scope of this paper and would require extensive computer simulation/support. What we are concerned with is the planning process required to allocate aircraft to missions based both on the threat and the mission requirement. We will assume (worst case that):  
The expected losses on side (A)=the number of side (B) fighters X Max expecting kill + Min expecting kill.

2

(Note: Max and Min expecting kill in Table 3)

**4.2 Depending on the idea that the main objective for the enemy attacking his targets, and depending on the structure of the MAS, then the calculation of the expected losses on both sides during MAS will be as follows:**<sup>16</sup>

First: Expected losses at the first interception line:

a. The forces from each side on the first interception line:

Aircraft Type	Fighters		Fighter bombers	
	MIG 21	F-16	F-4	F-10
The Two Sides				
The enemy side	24	-	-	-
Our side	-	13	18	12

b. The probability of engagement:

The Enemy Aircraft	Our Aircraft
16 MIG 21	13 F-16
4 MIG 21	4 F-4
4 MIG 21	4 F-16



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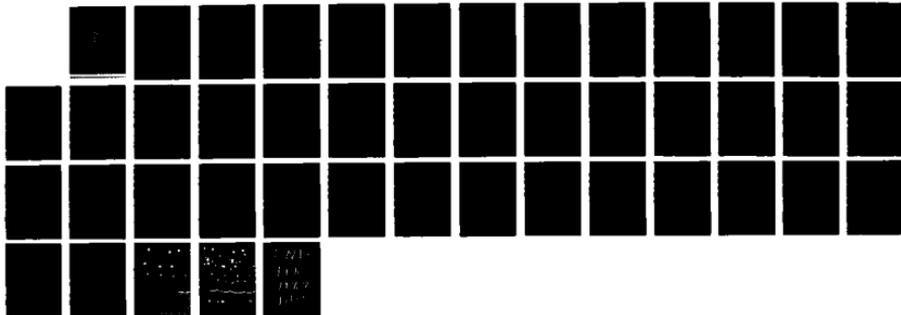
PLANNING FOR THEATER WARFARE USING THE CONCEPT OF  
MASSIVE AIR STRIKE TO INSURE SUCCESS(U) AIR WAR COLL  
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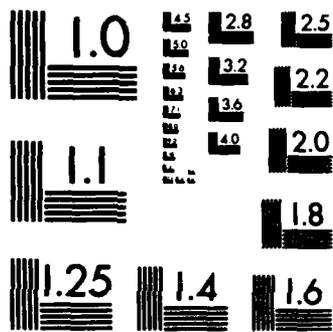
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(c) By MIG 21 (4) =

$$4 \times \frac{.214}{2} + .023 \times .6 = 0.28 = 1 \text{ F-16}$$

2

Total 4 Aircraft.

d. The total losses on the first interception line:

Aircraft Type			
The Two Sides	MIG 21	F-16	F-4
The Enemy Side	8	-	-
Our Side	-	3	1

\*4 F-4 and 4 F-16 (F/B) will unload and engage when attacked.

Second: losses at the second interception line:

a. The forces from each side on the second interception line:

Aircraft Type	Fighters				Fighter/Bombers	
	MIG 21	MIG 23	F-15	F-16	F-4	F-16
The Two Sides						
The Enemy Side	48	36	-	-	-	-
Our Side	-	-	14	40	18	14

b. The probability of engagement:

Enemy aircraft	Our Aircraft
16 MIG 21	8 F-15
24 MIG 21	16 F-16
8 MIG 21	8 F-4 (F/B)
8 MIG 23	5 F-15
24 MIG 23	24 F-16
4 MIG 23	4 F-16 (F/B)

c. The losses on the second interception line:

(1) The enemy losses:

(a) By F-15 (8) =

$$8 \times \frac{1.39 + .148}{2} \times .6 = 3.69 = 4 \text{ MIG 21}$$

(b) By F-16 (16) =

$$16 \times \frac{1.11 + .118}{2} \times .6 = 5.89 = 6 \text{ MIG 21}$$

(c) By F-4 (8) =

$$8 \times \frac{.719 + 0.077}{2} \times .6 = 1.90 = 2 \text{ MIG 21}$$

(d) By F-15 (6) =

$$6 \times \frac{.938 + 0.1}{2} \times .6 = 1.87 = 2 \text{ MIG 23}$$

(e) By F-16 (24) =

$$24 \times \frac{.75 + 0.08}{2} \times .6 = 5.97 = 6 \text{ MIG 23}$$

(f) By F-16 (4) =

$$4 \times \frac{.75 + 0.08}{2} \times .6 = 0.996 = 1 \text{ MIG 23}$$

Total 21 aircraft

(2) Our losses:

(a) By MIG 21 (16) =

$$16 \times \frac{.72 + .018}{2} \times .6 = 0.91 = 1 \text{ F-15}$$

(b) By MIG 21 (24) =

$$24 \times \frac{.214 + .023}{2} \times .6 = 1.70 = 2 \text{ F-16}$$

(c) By MIG 21 (8) =

$$8 \times \frac{.33 + .035}{2} \times .6 = 0.88 = 1 \text{ F-4}$$

(d) By MIG 23 (8) =

$$8 \times \frac{.273 + .029}{2} \times .6 = 0.73 = 1 \text{ F-15}$$

(e) By MIG 23 (24) =

$$24 \times \frac{.342 + .036}{2} \times .6 = 2.72 = 3 \text{ F-16}$$

$$(f) \text{ By MIG 23 (4) } = 4 \times \frac{.342 + .036}{2} \times .6 =$$

$$.46 = 1 \text{ F-16}$$

Total 9 aircraft

d. The total losses on the second interception line:

Aircraft Type					
The Two Sides	MIG 21	MIG 23	F-15	F-16	F-4
The Enemy Side	12	9	-	-	-
Our Side	-	-	2	6	1

8 F-4 and 4 F-16 will unload and engage.

Third: Losses at the third interception line:

a. The forces from each side on the third interception line:

Aircraft Type	Fighters				Fighter/ Bombers	
	MIG 23	MIG 25	F-15	F-16	F-4	F-16
The Two Sides						
The Enemy Side	24	80	-	-	-	-
Our Side	-	-	56	67	18	14

b. The probability of engagement

Enemy Aircraft	Our Aircraft
12 MIG 23	10 F-15
12 MIG 23	12 F-16
36 MIG 25	46 F-15
34 MIG 25	55 F-16
6 MIG 25	6 F-4 (F/B)
4 MIG 25	4 F-16 (F/B)

c. The losses on the third interception line:

(1) The enemy losses:

(a) By F-15 (10) =

$$10 \times \frac{.938 + .1}{2} \times .6 = 3.11 = 4 \text{ MIG } 23$$

(b) By F-16 (12) =

$$12 \times \frac{.75 + .08}{2} \times .6 = 2.99 = 3 \text{ MIG } 23$$

(c) By F-15 (46) =

$$46 \times \frac{.53 + .056}{2} \times .6 = 8.1 = 9 \text{ MIG } 25$$

(d) By F-16 (55) =

$$55 \times \frac{.424 + .045}{2} \times .6 = 7.7 = 8 \text{ MIG } 25$$

$$\begin{aligned} & \text{(e) By F-4 (6) =} \\ & 6 \times \frac{.254 + .029}{2} \times .6 = 0.96 = 1 \text{ MIG 25} \end{aligned}$$

$$\begin{aligned} & \text{(f) By F-16 (4) =} \\ & 4 \times \frac{.424 + .045}{2} \times .6 = .56 = 1 \text{ MIG 25} \end{aligned}$$

Total 26 aircraft

(2) Our losses:

$$\begin{aligned} & \text{(a) By MIG 23 (12) =} \\ & 12 \times \frac{.273 + .029}{2} \times .6 = 1.08 = 2 \text{ F-15} \end{aligned}$$

$$\begin{aligned} & \text{(b) By MIG 23 (12) =} \\ & 12 \times \frac{.342 + .036}{2} \times .6 = 1.38 = 2 \text{ F-16} \end{aligned}$$

$$\begin{aligned} & \text{(c) By MIG 25 (36) =} \\ & 36 \times \frac{.448 + .048}{2} \times .6 = 5.34 = 6 \text{ F-15} \end{aligned}$$

$$\begin{aligned} & \text{(d) By MIG 25 (34) =} \\ & 34 \times \frac{.56 + .059}{2} \times .6 = 6.31 = 7 \text{ F-16} \end{aligned}$$

$$\begin{aligned} & \text{(e) By MIG 25 (6) =} \\ & 6 \times \frac{.862 + .092}{2} \times .6 = 1.74 = 2 \text{ F-4} \end{aligned}$$

$$\begin{aligned} & \text{(f) By MIG 25 (4) =} \\ & 4 \times \frac{.56 + .059}{2} \times .6 = 0.74 = 1 \text{ F-16} \end{aligned}$$

Total 20 aircraft

d. The total losses on the third interception line:

Aircraft Type					
The Two Sides	MIG 23	MIG 25	F-15	F-16	F-4
The Enemy Side	7	19	-	-	-
Our Side	-	-	8	10	2

6 F-4s and 4 F-16s will be unloaded and engaged when attacked.

Fourth: Losses over target area:

a. The forces from each side over target area

Aircraft Type	Fighters					Fighter/ Bombers	
	MIG 21	MIG 23	MIG 25	F-15	F-16	F-4	F-16
The Two Sides							
The Enemy Side	28	32	20	-	-	-	-
Our Side	-	-	-	42	20	90	14

b. The probability of engagement:

The Enemy Aircraft		Our Aircraft	
28	MIG 21	14	F-15
20	MIG 23	20	F-16
12	MIG 23	10	F-15
14	MIG 25	18	F-15
6	MIG 25	6	F-4

c. The losses over the target area:

(1) The enemy losses:

(a) By F-15 (14) =

$$14 \times \frac{1.39 + .148}{2} \times .6 = 6.48 = 7 \text{ MIG 21}$$

(b) By F-16 (20) =

$$20 \times \frac{.75 + .08}{2} \times .6 = 4.98 = 5 \text{ MIG 23}$$

$$\begin{aligned} & \text{(c) By F-15 (10) =} \\ & 10 \times \frac{.938 + .1}{2} \times .6 = 3.11 = 4 \text{ MIG 23} \end{aligned}$$

$$\begin{aligned} & \text{(d) By F-15 (18) =} \\ & 18 \times \frac{.53 + .056}{2} \times .6 = 3.18 = 4 \text{ MIG 25} \end{aligned}$$

$$\begin{aligned} & \text{(e) By F-4 (6) =} \\ & 6 \times \frac{.254 + .029}{2} \times .6 = .51 = 1 \text{ MIG 25} \end{aligned}$$

Total 21 aircraft.

(2) Our losses:

(a) By MIG 21 (28) =

$$28 \times \frac{.172 + .018}{2} \times .6 = 1.62 = 2 \text{ F-15}$$

(b) By MIG 23 (20) =

$$20 \times \frac{.342 + .036}{2} \times .6 = 2.28 = 3 \text{ F-16}$$

(c) By MIG 23 (12) =

$$12 \times \frac{.273 + .029}{2} \times .6 = 1.08 = 2 \text{ F-15}$$

(d) By MIG 25 (14) =  
 $14 \times \frac{.448 + .048}{2} \times .6 = 2.04 = 3 \text{ F-15}$

(e) By MIG 25 (6) =  
 $6 \times \frac{.862 + .092}{2} \times .6 = 1.68 = 2 \text{ F-4}$

Total 12 aircraft.

d. The total losses over the target area

Aircraft Type	MIG 21	MIG 23	MIG 25	F-15	F-16	F-4
The Two Sides						
The Enemy Side	7	9	5	-	-	-
Our Side	-	-	-	7	3	2

3 F-4 will be unloaded and engaged when attacked.

Fifth: The expected losses on the way back. There are 20 aircraft (10 F-16s and 10 F-15s) whose mission is to protect the MAS aircraft on their way back from an airborne standby position (CAP). It is not possible to determine precisely the losses on this leg due to the difficulty of anticipating the number and type of enemy fighters that will chase our MAS aircraft. The capability of these 20 aircraft to destroy a standard fighter is equal to:

$$10 \times \frac{.974 + .104}{2} = 5.4 \text{ standard aircraft}$$

$$+ 10 \times \frac{1.22 + .013}{2} = 5.2 \text{ standard aircraft}$$

$$= \text{about 12 standard aircraft}$$

Sixth:

a. The total losses on both sides:

Aircraft Type						
The Two Sides	MIG 21	MIG 23	MIG 25	F-15	F-16	F-4
The Enemy Side	27	25	24	-	-	-
Our Side	-	-	-	17	22	6

b. The total F/Bs which will unload and engage:

Aircraft Type			
Interception Line	F-4	F-15	Total
First	4	4	8
Second	8	4	12
Third	6	4	10
Over Targets	3	-	3
Total	21	12	33

c. The reserve capability is to destroy 12 standard aircraft.

4.3 From the following table we can determine the expected results of IAS on the different interception lines:

IL. No.	First I.L.		Second I.L.		Third I.L.		Over	
	Our	Enemy	Our	Enemy	Our	Enemy	Our	Enemy
Targets								
Information								
No. of Fighters	13	24	54	84	123	104	62	80
N.o of F/Bs	30	-	32	-	32	-	104	-
Losses in Fighters	2	8	6	21	16	26	10	21
Losses in F/Bs	2	-	3	-	4	-	2	-
Total Losser	4	8	9	21	20	26	12	21
Total Aircraft	43	24	86	84	155	104	166	80
Ratio of Losses to the Total Aircraft	0.09	0.33	0.11	.25	.13	.25	.07	.25

(Attachment 1)

#### 4.4 The summary of the MAS results:

a. The total number of aircraft which participate in the MAS is 482 (first echelon 284 + AWACs, second echelon 186 + 10 reconnaissance aircraft, and third echelon 20).

b. The total fighters expected to engage the enemy on the different interception lines (first and second echelons) is 252 aircraft and the expected losses are 34 aircraft which is 13.5 percent.

c. The total number of F/Bs expected to participate in MAS is 198 aircraft. Their expected losses are 11 aircraft, which is 5 percent.

d. The total number of enemy fighters expected to intercept the MAS on the different interception lines is 202 aircraft. Their expected losses are 76, which is equal to 37.6 percent.

e. The total number of F/Bs which is obliged to unload and engage is 33 aircraft (i.e., does not complete its missions), which is equal to 17 percent (21 F-4 and 12 F-15).

f. The studies concerning aircraft losses to ground defenses shows us that we will lose about 7 aircraft to enemy ground defenses (3 fighters (1 F-15, 2 F-16) and 4 F/Bs (2 F-16, 2 F-4). We find that:

(1) The total expected fighter losses will be 37 aircraft, which = 14.6 percent attrition.

(2) The total expected F/B losses will be 15 aircraft, which = 7.5 percent attrition.

g. The total number of F/Bs expected to reach their targets and fulfill their missions is 150 aircraft. They are able to achieve the required effectiveness on their targets, because this number of losses has already been considered during the process of determining the number of F/Bs needed.

**SECTION 5: HOW THE MAS CONTRIBUTES TO THE PRIMARY**

**MISSION:**

**5.1 We can determine if the MAS contributes to the primary mission or not by examining the following:**

a. How much success it achieved in changing the air power balance.

b. How much success it achieved in supporting the surface forces' activities.

c. How much success it achieved in neutralizing the enemy main bases for the planned five hours.

**5.2 To determine the changes in the airpower balance, we have to compare the coefficient of superiority in fighters, F/Bs, and in general, before and after the MAS.**

**5.2.1 a. The fighters' coefficient of superiority before the MAS was 1.25 in our advantage (Section 2, Chapter 3).**

b. The F/Bs' coefficient of superiority before the MAS was .96 in the enemy's advantage (Section 2, Chapter 3).

c. The general coefficient of superiority before the MAS was 1.11 in our advantage (Section 1, Chapter 3).

5.2.2 The fighters' coefficient of superiority after MAS:

a. The enemy fighters' fighting efficiency:

Type of Fighters				The Total Aircraft
The Process	MIG 21	MIG 23	MIG 25	No.
No. of Aircraft of the type	93	85	96	274
The ratio of the type to the total no. of fighters	.339	.311	.350	1.00
The fighting efficiency factors	0.88	1.4	2.3	-
The ratio X the factor	0.298	0.435	.8050	1.538

The enemy fighting efficiency = 1.538

b. Our fighters' fighting efficiency:

Type of Fighters			The Total Aircraft
The Process	F-15	F-16	No.
No. of aircraft of the type	142	161	303
The ratio of the type to the total no. of fighters	.469	.531	1.00
The fighting efficiency factors	2.5	2.00	-
The ratio X the factor	1.173	1.062	2.235

Our fighting efficiency = 2.235

$$\text{Coefficient of fighters superiority} = \frac{303}{274} \times \frac{.9}{.9} \times \frac{\sqrt{2.35}}{\sqrt{1.538}}$$

= 1.34 in our advantage

5.2.3 The F/Bs' coefficient of superiority after MAS:

a. The enemy F/Bs' fighting efficiency:

Type of F/B		Su	Tu	The Total Aircraft
The Process	Mig 23	20-22	22	No.
No. of aircraft of the type	30	180	24	234
The ratio of type to the total F/Bs	0.128	0.770	0.102	1.00
The fighting efficiency factor	1.65	1.7	2.4	-
The ratio X the factor	0.2112	1.3090	0.2461	1.7663

The enemy F/Bs' fighting efficiency = 1.77

Type of F/B			The Total Aircraft.
The Process	F-16	F-4	No.
No. of aircraft of type	53	152	205
The ratio of type to the total F/Bs	.259	.741	1.00
The fighting efficiency factor	2.00	1.78	-
The ratio X the factor	0.5180	1.3198	1.8378

Our F/Bs' fighting efficiency = 1.838

$$\text{Coefficient of F/Bs' superiority} = \frac{205}{234} \times \frac{.9}{.9} \times \frac{\sqrt{1.838}}{\sqrt{1.77}}$$

= 0.90 in the enemy's advantage

5.2.4 The general coefficient of superiority after MAS:

a. The enemy general fighting efficiency:

Aircraft Type	MIG	MIG	MIG 23	MIG	SU	Tu Aircraft	Total Aircraft
The process	21	23(F)	F/B	25	20-22	22	No
No. of aircrafts type	93	85	30	96	180	24	508
The ratio of the type to the total aircraft	.184	.167	.059	.189	.354	.047	1.00
The fighting efficiency factor	.88	1.4	1.65	2.3	1.7	2.4	-
The ratio X the factor	0.1619	0.2338	0.0974	0.4347	0.6018	0.1128	1.6424

The enemy general fighting efficiency = 1.64

b. Our general fighting efficiency:

Aircraft Type	F-15	F-16 (F, F/B)	F-4	Total Aircraft No
The Process				
No. of Aircraft type	142	154	212	508
The ratio of the type to the total aircraft	0.280	0.303	0.417	1.00
The fighting efficiency factor	2.5	2.00	1.78	-
The ratio X the factor	0.7000	0.6060	0.7423	2.0483

Our general fighting efficiency = 2.05

$$\text{The general coefficient of superiority} = \frac{508}{508} \times \frac{.9}{.9} \times \frac{\sqrt{2.05}}{\sqrt{1.64}}$$

= 1.12 in our advantage.

5.2.5 The comparison of the coefficient of superiority before and after MAS is as follows:

Coefficient of Superiority	Fighters	F/Bs	General
Before MAS	1.25	.96	1.11
After MAS	1.34	.90	1.12

From the above table we find:

a. The F/Bs' coefficient of superiority improved only by .06 towards the enemy side, even though our F/Bs accomplished their assigned missions and at the same time the enemy F/Bs did not achieve any mission. Also, I did not consider any losses in the enemy F/Bs even though there is a probability for some losses in the enemy F/Bs on the ground during our attacks on the enemy air bases, especially those in the standby positions.

b. The general coefficient of superiority improved very slightly to our advantage (.01), even as we accomplished the MAS objective in supporting the air land battle activities.

c. The fighters' coefficient of superiority improved by .09. This will affect significantly the enemy fighters' capability to protect their targets and forces. By continuing the MAS against the enemy targets, his ratio of attrition will increase and he will use part of his F/Bs as fighters. These have less capability due to the aircrafts type and the pilots' training. This improvement in the coefficient of our fighters' superiority will enable us to continue to achieve our role in the air land battle successfully, especially if we consider that the enemy's fighters losses were 76 aircraft and our losses were 37 aircraft, the ratio being about 2:1 in our advantage.

**5.3 To know that the MAS succeeded to support the land forces' activities, we reviewed the following expected results:**

a. 75% of our F/Bs (after discounting 7.5% for expected losses and 17% to unload before fulfilling their missions) were able to accomplish their missions, which included the close air support targets requested by the surface forces.

b. The enemy's losses in fighters (76 aircrafts) will oblige him to use F/Bs as fighters, which may affect his capabilities to accomplish his missions against our surface forces.

5.4 The 75% of the F/Bs which we planned to neutralize the enemy's main three bases are able to achieve their mission by neutralizing those bases for five hours. This permits the following:

a. During this period, our fighters will have air superiority and they will be able to fulfill their missions with the minimum effort. At the same time, our F/Bs will be able (after refuel and reload) to accomplish any other missions without any effective interference from the enemy's fighters.

b. During the period of five hours, our surface forces will be able to achieve their missions without any effective interference from the enemy F/Bs.

5.5 If we launched the first MAS early in the morning and launched another MAS within five hours, we could enable our surface forces to operate for about 10 hours under our air superiority (air protection) without any effective activities from the enemy F/Bs, for the same period (the daytime). Our F/Bs will be able to support the surface forces activities successfully.

## CONCLUSIONS AND RECOMMENDATIONS:

1. In modern war, airpower is employed most effectively as part of a combined-arms operation where all services cooperate to accomplish one mission or objective. On all levels that exist in an armed conflict, victory can best be achieved through combined forces operations, the application of sound principles, and seizing and holding the initiative. Airpower has an important role in each of these levels.

2. In war, the air force achieves its role by accomplishing two groups of missions relative to the Air Land Battle. The first group (strategic aerospace, aerospace maritime operations, airlift, special operations, and aerospace surveillance and reconnaissance missions) has no direct affect on the Air Land Battle. They are relatively independent, often need a higher authority decision to be implemented (e.g., at the national level), and are characterized by sufficient planning time before execution. The second group (air interdiction, counter air, and close air support missions) is related directly to the Air Land Battle and requires a continuous coordination with other activities in order to achieve its objectives.

3. The forces which carry out the second group's missions (tactical missions) must be stationed in the operational theater for responsiveness and are composed mainly of fighters and fighter/bombers. To achieve their objectives,

we have to plan within the same time frame and in close coordination with the surface forces activities. Because of the rapid changes and the decisive maneuver which characterize modern warfare, the time available for planning is relatively short. This lack of time demands that planning be done in the operational theater under one command.

4. The impressive improvements in enemy air defense capabilities and associated probabilities of kill, require that the two main objectives of the theater airpower (support the surface forces activities and gain, improve or keep air superiority in the operational theater) be achieved with minimum losses. The concept, that enables us to achieve these objectives during the Air Land Battle, considering the destructive enemy capabilities is the Massive Air Strike (MAS).

5. MAS is the concept of deploying all the available airpower in the same time period (a very short period) to accomplish most of the airpower missions. MAS would decrease the attrition rate in our aircraft more than if we tried to accomplish each mission independently. Also, MAS gives us a relative advantage because the enemy has a limited capability to use his fighters against our fighters, due to the short time available (MAS period) when our forces are concentrated over his area.

6. MAS achieves the main two missions of theater airpower simultaneously. It achieves the first mission (supporting the surface force's activities) by attacking the air interdiction and close air support targets. It achieves the second mission (air superiority) by a preplanned air-to-air campaign to improve the coefficient of superiority in our advantage and by attacking the enemy air bases to gain a period (4-5 hours) of air superiority in the operational theater (Note: This also supports surface forces activities by denying the enemy F/Bs the capability to attack our forces).

7. The planning to direct MAS is a good example of applying the principles of war as follows:

a. Surprise, Initiative, and Offensive: MAS is an offensive action because it plans to attack the enemy targets in different depths simultaneously with a preplanned air-to-air campaign against enemy interceptors. To achieve surprise in the MAS, one selects the best time to launch MAS or attacks targets all over the operational theater, thus degrading and confusing the enemy air defense system. Also, surprise may be achieved by our coefficient of superiority in fighters on the all interception lines. Offensive action and achieving surprise are the ways to gain the initiative. By continually directing the MAS against the enemy, we can keep the initiative on our side in the air battle.

b. Economy of Force, Unity of Command and Security:

The centralized planning of the MAS under the theater airpower command achieves the principle of unity of command at the same time it enables us to calculate the needed numbers of fighters and F/Bs to accomplish the assigned missions. The three echelons of MAS (secure, main, and reserve) achieve the security principle.

c. Mass, Concentration, and Maneuver: MAS enables us

to use most of our airpower and mobilize it in mass by directing successive, intensive attacks on well-chosen targets in a short time concentrating on the important targets to support the surface force's activities in addition to the enemy air bases. '

d. Objective, Cooperation, and Simplicity: MAS has a

clear objective to achieve airpower role in the operational theater by supporting the surface force's activities. To do that requires a high level of cooperation and coordination between these forces. At the same time, MAS requires extensive coordination among the aircraft in the three MAS echelons. This close cooperation between airpower and surface forces and among MAS forces achieves the simplicity principle.

8. During the planning process and the comparison between the two air forces and the calculation of the various coefficients of superiority, we have to consider the

fighting efficiency factor of each aircraft type. Depending only on the number of aircraft would lead to a false estimate and an erroneous calculation. As a result of this and due to the significant impact of the aircraft fighting efficiency, we must continue improving our fighters and F/Bs' capabilities by updating their weapon systems, munitions, and avionics. Also, we need to improve continually our aircrafts' aerodynamic flying performance (e.g., speed, range, maneuverability) through modifications.

9. During this study, we find that if we plan to have a relative coefficient of superiority in fighters equal to 1.25, the attrition ratio will be 2:1 in our advantage. This ratio enables us to improve the coefficient of superiority on our side as the hostilities continue.

10. Figuring the expected results of MAS in advance and placing them before the commander who has the authority to decide if we launch MAS or not is very important. This is because it shows the expected relative attrition on both sides (number and type of aircraft) and its effect on the different coefficient of superiority. Also, it shows the F/Bs' ability to attack enemy targets and the expected results. Our attacks assist the coordination with the surface forces because they now know which targets may be uncovered (e.g., no F/Bs available) and can therefore prioritize their requirements.

11. Continuous MAS will enable us to accomplish the airpower role in the Air Land Battle by achieving air interdiction and close air support objectives. Also, it will enable us to improve the coefficient of superiority. In other words, it greatly assists the other armed forces to take and hold the initiative.

12. This entire paper is based on a worst case estimate (from our point of view) and rough numbers. I did not have access to a sophisticated computer to run attrition numbers. What is important is that MAS is a planning process for efficient allocation of air to achieve support for ground forces and air superiority.

13. If we put the information needed for the planning process into a software program, it will help to plan MAS in a very short time using the micro computer. This will be very important due to the rapid changes in the operational theater which affect directly the priorities of choosing the targets, especially close air support targets.

14. Ideas in this paper--to include calculations--are based on relative merit. It cannot replicate the absolutes of the real world but can give us trends which will cause us to continually upgrade our airpower.

15. Finally, I tried in this study to develop a new concept (MAS) for the use of theater airpower, and the proper way of planning for and directing these MASs. I hope it will help to put Air into the Air Land Battle.

## FOOTNOTES

1. See the Introduction to Lieutenant Colonel John S. Doerful, "The Operational Art of the Air Land Battle", Military Review, May 1982.
2. AFM 1-1 Basic Aerospace Doctrine of the United States Air force (USAF), Chapter 3, pp. 2-3.
3. Ibid., Chapter 3, pp. 3-5.
4. Ibid., Chapter 3, pp. 5-6.
5. Ibid., Chapter 3, p. 4.
6. Ibid., Chapter 3, p. 5.
7. Ibid., Chapter 3, p. 3.
8. Ibid.
9. Ibid.
10. Ibid.
11. Ibid., Chapter 3, pp. 3-4.
12. Ibid., Chapter 3, p. 4.
13. A previous study I did for ACSC in the EAF about the relation between the general comparison of forces and the expected attrition, shows that if the ratio

general efficiency of friendly forces is less than 0.7,  
general efficiency of enemy forces

our attrition will be unacceptable if we try to accomplish all the Air Force's theater missions at the same time

(MASs). We have to concentrate on improving the ratio to our side by achieving the counter air mission. If the ratio is 1.5 or greater, it means that our Air Force will be able to achieve its goals during the operation period. If the ratio is between 0.7 and 1.5, it means that we are able to fulfill the missions which are needed to support the surface forces, but at the same time we need to work continuously to improve the comparison ratio to our side. In other words, if the ratio is in the 0.7 - 1.5 range, it is prudent to launch MASs.

14. From experience and during the study I mentioned above, I found that the fighter superiority ratio of 1.25 permits us to make an attrition ratio approaching 2:1 over the enemy fighters in air-to-air fighting. That is why I assumed this ratio in my paper, but depending on the available fighters in the operational theater, we can use another ratio knowing that the enemy's fighter losses ratio will increase or decrease relative to the change in this ratio of fighters' superiority.

15. This formula considered the number and type of aircraft to provide a more realistic idea about the airpower efficiency. It attempts to quantify certain variables to

achieve an objective look at possible outcomes of force engagement.

16. To calculate the losses on both sides, I followed these steps:

a. Figure the number of enemy fighters and the number of our fighters and F/Bs on the interception line. (Know from Chapter 3, Section 3)

b. Figure the expected engagements on the interception line. To do that, I assumed that the enemy fighters have a clear objective to prevent our F/Bs from attacking their targets. That is why he will direct a number of his fighters against our fighters. (This number is equivalent to the fighting efficiency of our fighters on the same interception line 1:1.) Then, the rest of his fighters will be directed against our F/Bs. At the same time, only our F/Bs which will be attacked will unload and engage and the others will continue their missions.

c. After figuring the probability of engagement, I then figured the expected losses on the enemy side done by our fighters and F/Bs, and the losses to our side is done by enemy fighters. Considering the type of aircraft and using Table No. 3, I also used a probability of participation of 0-6 because Table No. 3 is for 1 vs. 1 fighting and I know from experience that not every aircraft will really fight. (I assumed that 60% only would fight.)

TABLE 1

## "COEFFICIENT OF FIGHTING CAPABILITY FOR SOME AIRCRAFT"

No	The Missions The Type	Air-to-Air	Air-to-Ground	Reconnaissance
1	MIG 21	0.88	1.00	-
2	MIG 23 (Fighters)	1.4	-	-
3	MIG 23 (F/B)	1.3	1.65	-
4	MIG 25	2.3	-	2.5
5	SU 20-22	1.3	1.7	-
6	TU 22	-	2.4	-
7	F-4	1.3	1.78	2.1
				(F-4 <sub>R</sub> )
8	F-16	2.00	2.00	-
9	F-15	2.5	2.00	2.5

Table derived from official sources.

**TABLE 2**  
**THE NUMBER OF F/Bs NEEDED TO NEUTRALIZE**  
**OR DESTROY THE EXPECTED TARGETS**

	Area and	Air-to-Ground Missiles/Guns	Bombs
Targets	Composition of Targets	No of Aircraft to Destroy/ Type Neutralize	No of Aircraft Type to Destroy
Missile Site	300 X 500 M (6 Launchers and 4 Radars)	Maverick 10/4	High 10 Explosive Bombs
Radar Site	2-3 Antenna	Radiation 2/- Seeking Air-to-Ground Missiles	Rockeye/ 2 Cluster Bombs
Command and Control Pdst.	500 X 800 M	- -	Rockeye/ 6 Cluster Bombs
Artillery Position	12 Guns	Maverick 18/8	High 18 Explosive Bombs
Tank Company	100 X 100 M 12 Tanks	Maverick 24/12	High 36 Explosive Bombs

Remarks: To keep this paper unclassified, I used an approximate number of aircraft in the above table. To get accurate numbers, we have to use the classified tables (JMLMS).

TABLE (3)

THE MAXIMUM AND MINIMUM PROBABILITY OF KILL  
TYPE OF AIRCRAFT WHICH HAD BEEN ATTACKED

TYPE OF ATTACKING AIRCRAFT	MIG 21		MIG 23		MIG 25		F-4		F-16		F-15	
	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
MIG 21	.487	.052	.330	.035	.180	.019	.330	.035	.214	.023	.172	.018
MIG 23	.776	.083	.487	.052	.297	.032	.525	.056	.342	.036	.273	.029
MIG 25	.127	.135	.862	.092	.487	.052	.862	.092	.560	.059	.448	.048
F-4	.719	.077	.487	.052	.254	.029	.487	.052	.317	.034	.254	.027
F-16	1.11	.118	.750	.080	.424	.045	.750	.080	.487	.052	.390	.042
F-15	1.39	.148	.938	.100	.530	.056	.938	.100	.510	.065	.487	.052

REMARKS:

1. This table depends on the fighting coefficient factor for each aircraft (table 1). It means that any change in aircraft capability (using new minimums, new avionics syst, etc.,) will change its fighting coefficient number. Hence, it's probability of kill or to be killed by another aircraft also will change.
2. The numbers in this table express the probability of kill for the type of aircraft when it engages with any of the aircraft in the table, regardless of the pilots capabilities.

Attachments "1"

Enemy warning direction

IL "1"

2

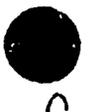
3

Reder Line - Structure destruction



IL "4"

a/c No.	
Loss	Participated
10	62 ↑
2	104 ↑
21	80 ←



a/c No.	
Loss	Participated
2	13 ↑
2	30 ↑
8	24 ←

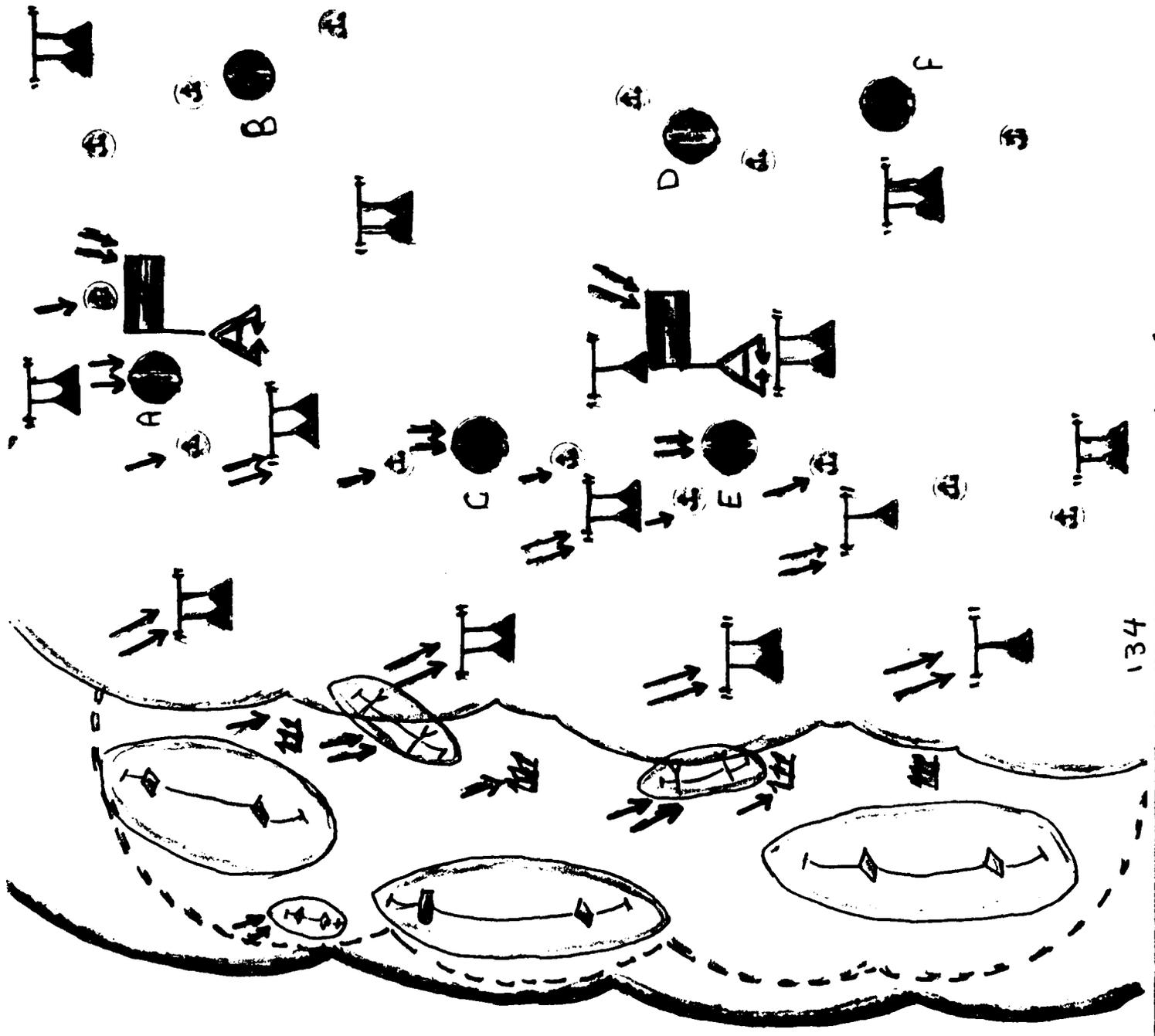
a/c No.	
Loss	Participated
6	54 ↑
3	32 ↑
21	184 ←

a/c No.	
Loss	Participated
16	128 ↑
4	63 ↑
26	104 ←

Our fighters	↑
Our fighter/bombers	↑
enemy fighters	↓

Attachment "2"

		Command and control post.
		Radar site.
		enemy air base
		Missile site
		Mobile SAMs
		missile engagement zone
		Mobile SAMs engagement zone
		Radar detection



END

FEB.

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